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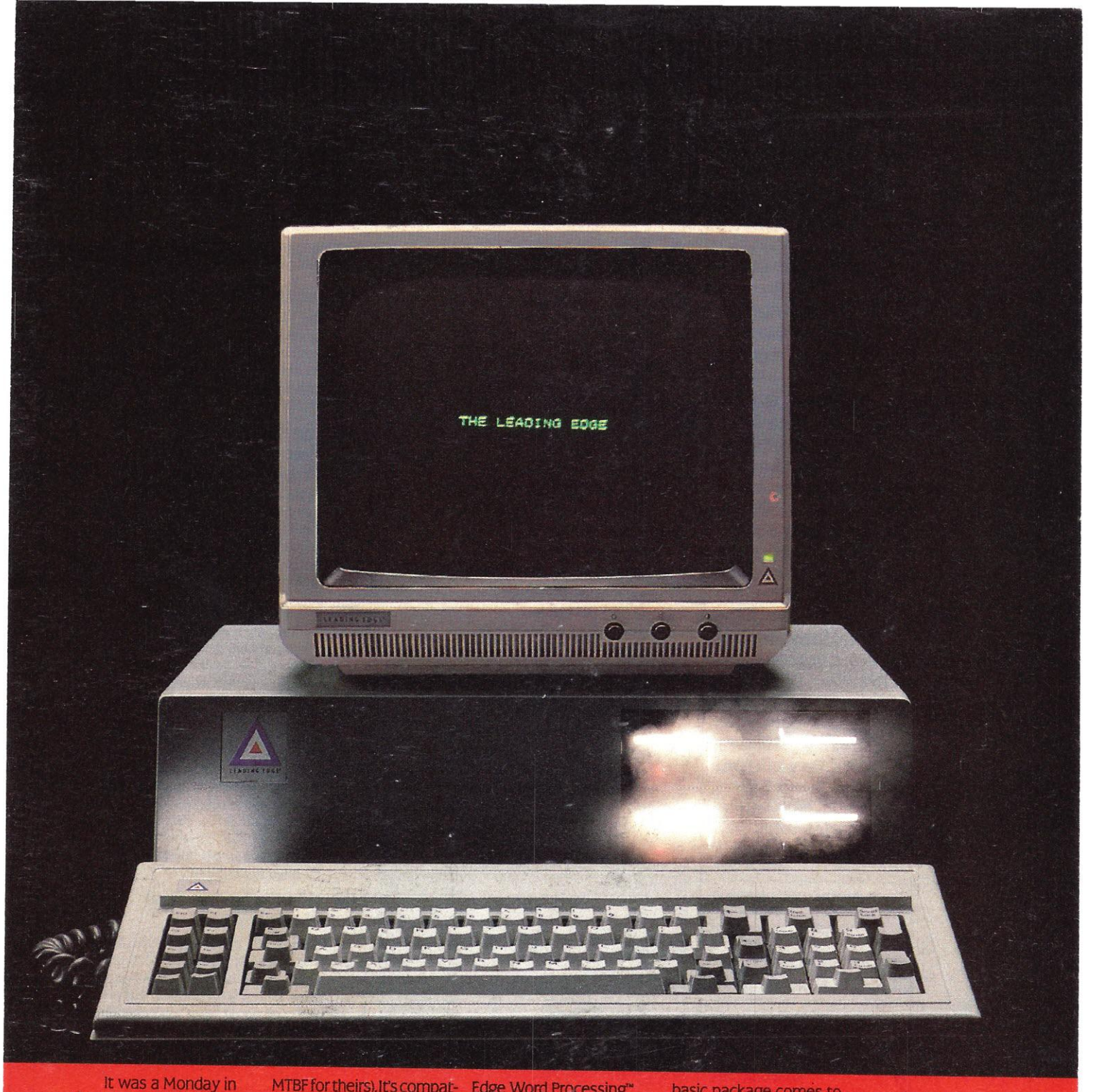


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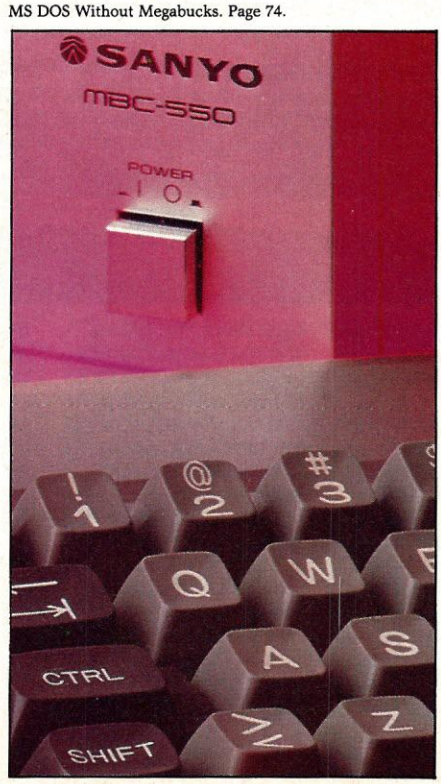
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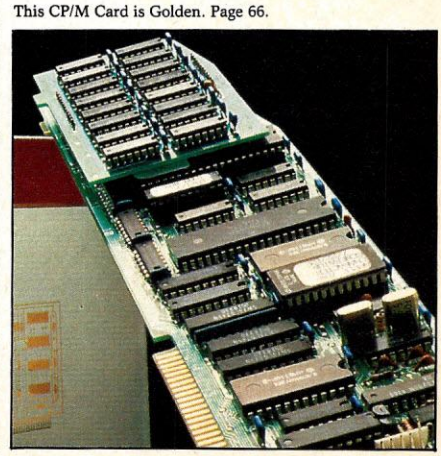
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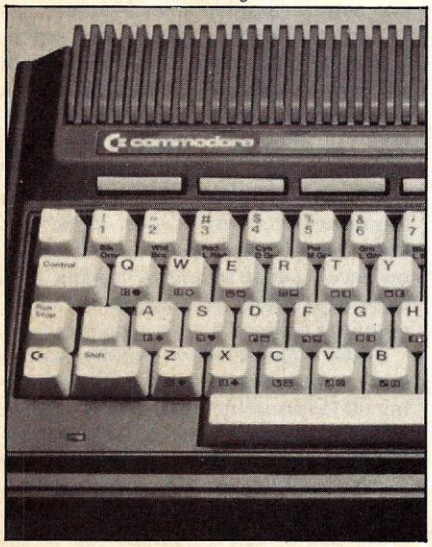
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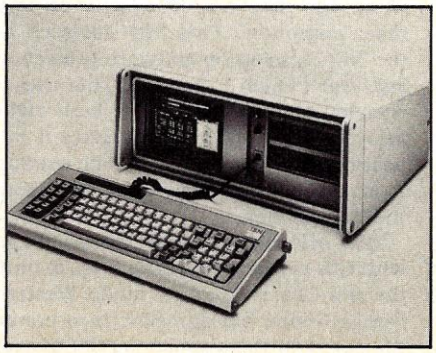
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By Wayne Green

The Chinese Syndrome

Seductive Software Scams

As if Apple isn't having enough trouble with those wily Chinese on Taiwan and in Hong Kong who are cranking out remarkably good copies of the IIe and selling them for half to a third of the price of the real thing, last year Taiwan was outselling Apple worldwide for a while.

Apple tried to use legal action in both Taiwan and the U.S. Customs to stem the torrents coming into the United States. With 100 small firms making them, as soon as one firm was stopped by court action, two others sprang up. I'm convinced there was a faster, cheaper and much more effective way out of this hassle.

The Royal Scam

Now there's a new Chinese scam—software rental. A firm has been submitting full page ads to computer magazines offering any Apple or IBM program, complete with a manual and disk, for just $10 FOB Taiwan. By the time you add in duty, shipping, and so on, this comes to $16.54—not bad for a Lotus 1-2-3 or WordStar package. That's for a one-year rental, it says in their ad, but I suspect that no one is ever going to ask for anything back.

How can they sell them that cheap? Well, first you have to remember that Taiwan has no copyright agreement with us. When you visit Taiwan, you see this in the hundred or so computer and book stores. They're packed solid with shelves of locally offset printed copies of virtually every computer book available in the United States, all at unbelievably low prices. So, yes, they can run off a copy of WordStar, complete with the instructions, and sell the package for a good profit at $10. Of course WordStar doesn't get a nickel out of this.

Is this something we should worry about, or should we all just jump on the bandwagon and buy anything we want for $16.54, snickering at the U.S. manufacturer of the program? The normal reaction is to loudly decry this rip-off, but then take advantage of it, so don't go feeling too guilty. I'll bet I could sell the address of this outfit for $25 and make a fortune.

As in the case of the California firm offering to sell software on trial, one thing is for sure: some magazines are going to sell their honor for the price of a full-page ad for this Taiwan outfit. Something like this could put the whole industry out of business.

The industry is hurting just from the copying of programs by friends, user's groups, unscrupulous computer stores, computer campers and people in offices. One of the reasons disks sell so incredibly well in business districts is that many employees with home computers run off copies of all the software owned by the business.

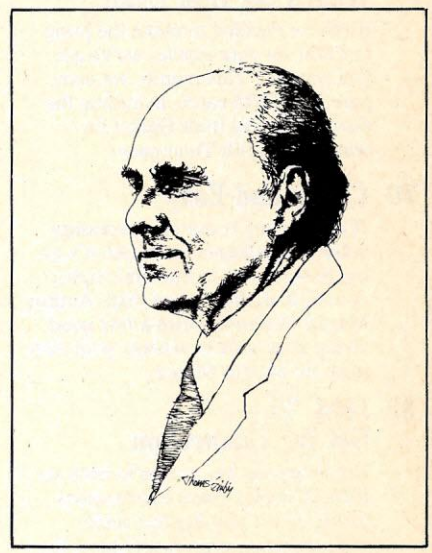
Well, this is okay as long as there are enough firms to try and sell software under these conditions. One unstopped firm "renting" software or selling it on a trial basis could kill the whole shaky industry. As soon as a few desperate magazines publish the Taiwan ad, we could see things start to fold up.

Reasonable Answers

The only reasonable answer to all this, of course, is to protect software against copying. The problems with this concept in the past have been that the protection systems used often made it difficult to make a back-up copy of the program. Some protection systems slow down the program. None have been undefeatable, even by relative amateurs. No, as soon as a new protection scheme is used, another firm puts a program or a board on the market to beat it.

There *is* a protection system that allows you to make all the copies you want, but they just won't run on any other computer. This first surfaced at the NCC session on software protection last year (which I chaired). This uses a decoder and serial number built right into the CPU chip, which makes it impossible to get around. You'll be reading more about this ingenious invention, the Copyrighter.

Most software firms are anxious to go with this system, but it won't work until the new CPU chip can be made. Western Design Center has agreed to incorporate the circuit in their upcoming 65802 and 65816 chips. These are the new high-



speed versions of the 6502 that GTE and Hayden are promoting. These chips will plug into any Apple II or IIe and allow much higher speed programs to be run.

Only something like this can stop the imminent crash of the software business. Would you pay several hundred dollars for WordStar if you knew you could get it from Taiwan for $16.54? And the market for American-made 1-2-3 packages just has to weaken if Taiwan starts selling them for $16.54.

If you read the classified papers, you're seeing the same thing I am: hundreds of ads for secondhand software. We did a little calling to see if these ads are working. Yes, they are. Unlike a used car, where you are buying someone else's headaches, used software can't be distinguished from new. And, as far as I know (and I know pretty far), there are no laws against selling or buying used software—unless you signed an agreement not to resell it when you bought it.

Those Chinese seem awfully slow at some things, but their speed at knocking off (copying) new software, complete with the instruction book, is incredible. You don't get rich by being careless with money, so if I didn't get review copies of most software I suspect that I might come home with a suitcase full of $10 bargains each year when I visit Taiwan.

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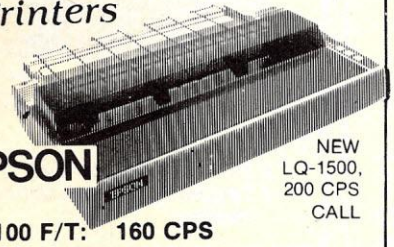


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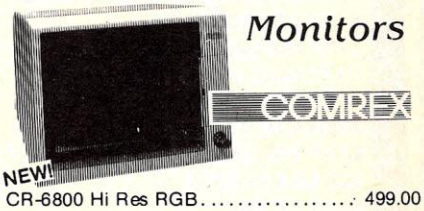
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Freeloaders

Yes, I know about the complaints that software is too expensive. Well, with between 50 percent and 95 percent of it being ripped off as it is, what do you expect? You have to remember that you are, in essence, paying for two freeloaders when you buy a software package. Thus, it's possible that the price of software could drop to one half or even a third of the current levels if every copy used were actually paid for—and this is what a good protection system could guarantee.

It's an agonizing decision, of course—like the joke about watching your mother-in-law go over a cliff in your new Cadillac. Sure, we'd all like to see software prices at a third of what they are today, but would we be willing to agree to pay for all the software we use in return?

We would all like to see software prices at a third of what they are now, but how many are willing to pay for all the software we use in return?

This would cost a few people a lot, a few a little and some would win handsomely. The big losers would be, I suspect, the schools. They've gotten so used to mimeographing copyrighted material for their classes that they've really seen nothing wrong in running off copies of classroom software for their students.

My own software firm used to produce educational programs. In the early days, as I've mentioned before, we used to find that we would sell one copy of each new educational program to a school. Then we'd get hundreds or even thousands of letters from the kids telling us how great the programs were. But the schools wised up, and we then found that we were selling one program to each school district. We got the hell out of the educational software business.

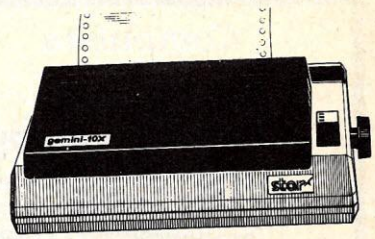
With each program able to run on one (and only one) computer, it might be possible for software firms to start writing good educational software. The prices could be quite low and still encourage the heavy investment in programming, publication and advertising it takes to be successful. □

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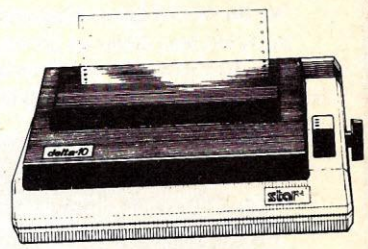
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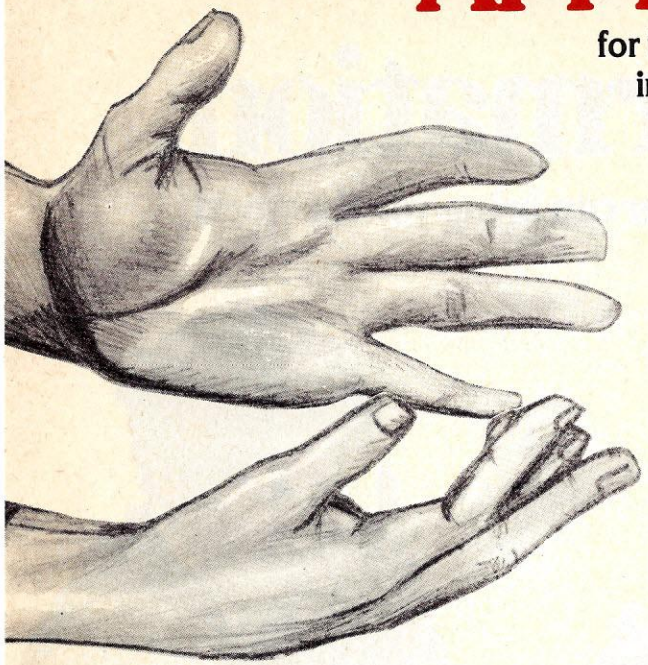
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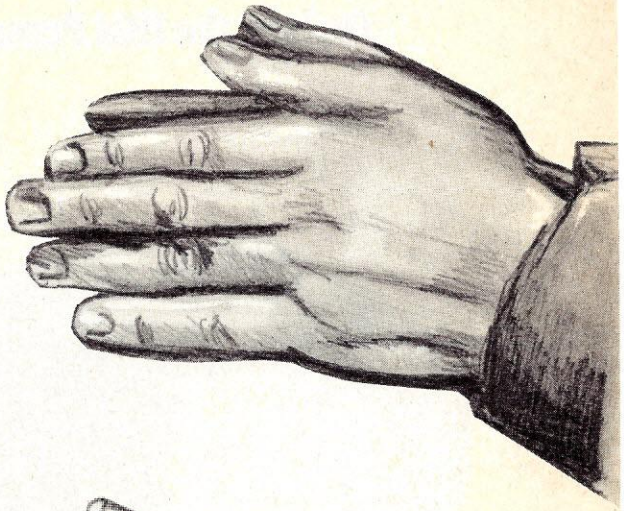
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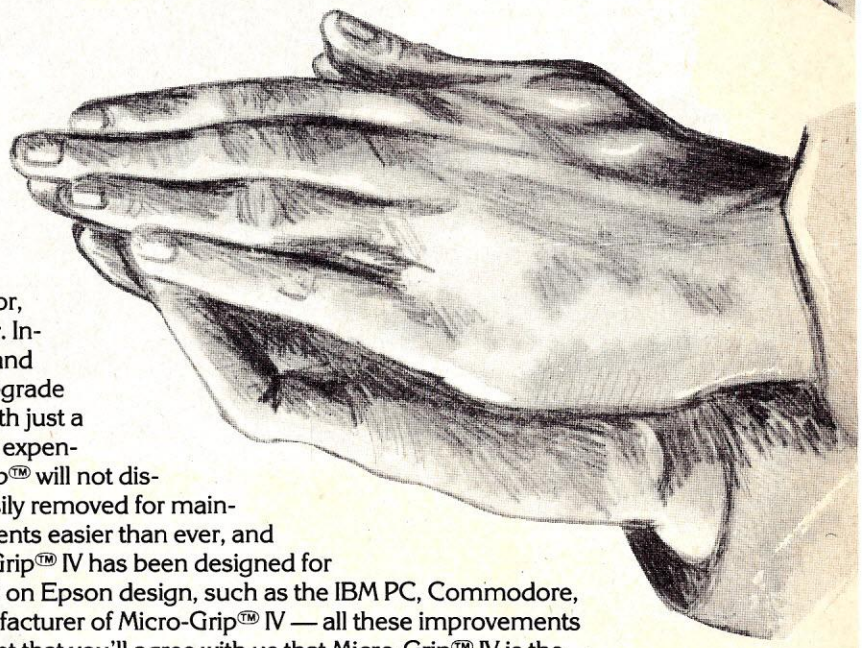
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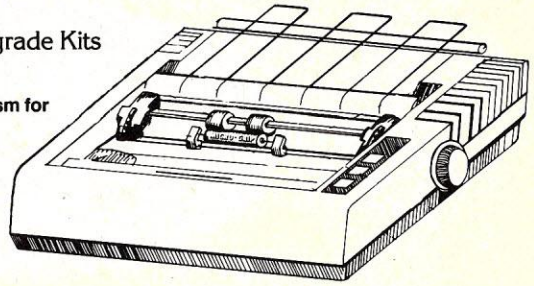
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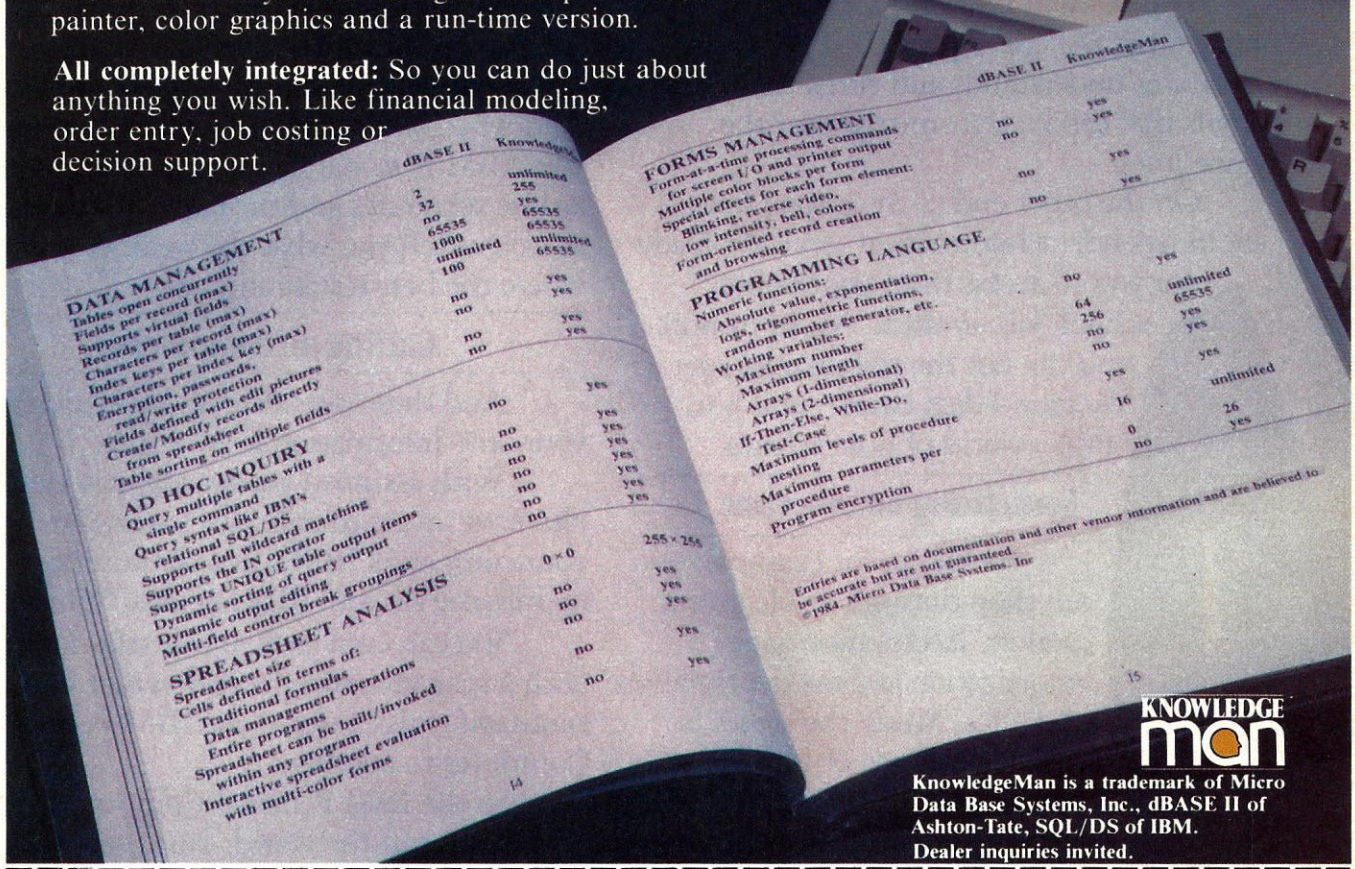
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LETTERS TO THE EDITOR

A Pioneer Speaks Out

I'm happy to see *Microcomputing* return to a more technical bent. I've heard a lot of disgruntled readers complain about what has happened to a once-great magazine. I'm convinced that going to a more technical format will bring back some of the early readers.

I think this is an area that is not served by any of the other lookalike magazines, and one that is sorely missed by a lot of the early pioneers in home computers.

Pete Stark
Mount Kisco, NY

Reply:

Peter, thanks for your letter. We have changes in June that will pleasantly surprise. Stay tuned.

Editors

Where to Start?

Your editorial, published in the November 1983 issue of *Microcomputing* ("How to Succeed . . ." p. 6), was most interesting. I am in agreement that the industry does need more adequate representation; however, I'm at a loss for a starting point.

Is there, other than the current periodical structure, some central clearing point where I can find a listing of the manufacturers serving both hardware and software needs for the computer industry?

I am an Osborne 1 owner who finds the only difficulty with my machine to be the lack of a supporting company. I would appreciate any further thoughts your readers might have.

Stanley Rakieten
4831 Spring Circle
Minnetonka, MN 55343

Columbia: The Gem of Portables

I am the proud owner of a Columbia Portable for six months now. Please allow me to speculate on why your magazine rarely prints an article about and/or including the Columbia family of PC compatibles.

Is it because they don't contribute their hardware or software? Maybe because your "generous advertisers" might get upset? Or is it simply because no other manufacturer can offer a completely compatible computer including $1500 worth of free software for their prices? Could it be you feel that it's immoral to underprice all the leading manufacturers and it could mean economic disaster for many of your aquaintances?

Whatever your reasoning, don't you think it is time for the public to know there is a compatible out there for half the cost with some good software? I always thought the press was to print the truth even if it is rather unpleasant to the majority of its contributors and advertisers. C'mon guys, let's get with it.

I hardly hear anything about my Columbia, and since it is totally compatible, I can only guess it is a combination of the above motives. I certainly hope you have the integrity to print this. Have a nice day.

Fred Tabaracci
New York, NY

Reply:

Calm down for a second, Fred. We have a Columbia portable out being reviewed right now. Our report will be published soon. Have a nice day too.

Editors

Eastern OKs Laptops

In December, we published an editorial decrying the ban on laptop computers by Eastern Airlines. The following release was issued by Eastern on January 31, 1984.

Effective Feb. 1 Eastern Airlines will permit passengers to use personal computers and other electronic equipment onboard the aircraft.

Eastern reached the decision after extensive testing showed no evidence that these instruments interfere with aircraft navigation and communications equipment. Electronic equipment tested and approved for onboard use includes personal computers, electronic games, solid state calculators, hearing aides, heart pacemakers and portable recorders.

Eastern will continue to prohibit the use of walkie-talkies, radio controlled toys, portable telephones and radio and television receivers onboard. And, as a precautionary measure, personal computers and voice recorders must be stowed away in overhead racks or underneath the seats during take-offs and landings.

Bring Back Buyer's Guides!

I've always wanted to get up the courage to write a letter to the editor. Well, I've finally had it! I just wanted you to know that I am very disappointed that you no longer publish buyer's guides. I found the guides most informative and fun to read. I think that you are doing the computer user a great injustice by no longer publishing buyer's guides.

I realize that there were a few fools who complained about the guides being a waste of paper, but what do they know, huh? Well, keep up the good work at *Microcomputing*, you guys just aren't the same lately . . .

Robert Bumblok
Westchester, NH

Reply:

We're re-evaluating the issue of buyer's guides (pun intended). What do you other readers think? Should we run buyer's guides?

Editors

Not So Amazing

Today I picked up a copy of the February issue of *Microcomputing*, which contained my article "Amazing Game, How Sweet the Sound" (p. 46).

The two paragraphs describing travels in the Maze of Twisty Little Passages, All Alike is not accurate, and the accompanying Table 6 is also wrong. Anyone trying to follow the directions as given in the table as printed will get hopelessly confused.

I've included corrections to both the text and Table 6. The beginning and ending on the corrected text and the affected paragraphs are the same. I'll send a copy of the corrections to anyone who writes me about the article.

Paragraphs 4 and 5 on page 50 should read:

Try south—another dead end. Hmm. Okay, north. Aha, new territory: MTyL 4. (Drop something.) West? No, "you can't go that way!" Give it a zero.

East? Takes you back to MTyL 2! Grrr. West again, and you're back at MtyL 1. Alright then, west! MtyL 5, good. (Drop something.) West again, and you're in: MTyL 5!? East, maybe. No, can't go that way; zero. South? Loops back on itself again! Arrgh! North? Back to MtyL 1 again. South? MTyL 3. South from here is a dead end, remember? How about north? MTyL 4. Try south again: MTyL 6! But now you're out of objects to drop.

Table 6 on page 50 should read:

Table 6. In the Maze of Twisty Little Passages, All Alike.

	N	E	S	W	U	D
MTyL1		2	3	5		
MTyL2		3	4	1		
MTyL3	4	DE	DE	1		
MTyL4		2	6	0		
MTyL5	1	0	5	5		

Sorry for the mix-up and I hope this'll clear things up a bit.

Dafydd Dyar
Omaha, NE

And The Shows Go On

Luckily, it didn't take the microcomputer industry long to realize that there were just too many computer shows. Last year may make history as the year of shows.

There were Applefests, IBMfests and CP/Mfests from coast to coast. However, exhibitors grew weary of traipsing around the country playing to declining audiences. By the end of 1983, show promoters had wisely consolidated many of the show dates scheduled for this year.

As some shows were eliminated, a new one was added to this year's schedule. Softcon ran from February 21–23 at the New Orleans Superdome. It was produced by Northeast Expositions as an all-software computer show. The show was interesting for many reasons. Oddly, it was dominated by hardware rather than software. Most of the crowds accumulated around IBM at one end of the Superdome and Apple at the other.

The new IBM portable drew curiosity seekers wondering, I suppose, if IBM had any new keyboard surprises on the portable. No surprises, though. The portable has the same keyboard layout as the PC. However, although the keyboard is lighter—it doesn't do much to shave off the 30 pounds the unit weighs.

There were a few major software announcements regarding the Tandy 2000. Tandy had a private showing that compared the 2000 and PC side by side. Both 1-2-3 and SuperCalc3 were running.

The speed of the 2000 is astounding. We verified Tandy's benchmark that ran a 1-2-3 sheet over 2.5 times faster on the 2000 than on the IBM PC. Graphics on the 2000 are superior, too.

Ovation Technology's integrated software is also a powerful package. It is none too soon that Tandy is encouraging third-party software publishers. A machine like the 2000 deserves the best possible software. These three packages should help Tandy sales.

K.T.

Sneak Previews

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The Practical Journal of Advanced Computing

In June, we'll introduce what can only be described as the "new" *Microcomputing*.

For the last eight months, we've been working on ways to make *Microcomputing* a better magazine. We've redesigned the logo and the interior in order to make *Microcomputing* easier and more enjoyable to read.

However, the changes go far beyond just a new look. We've learned by listening to your comments and ideas. We know what you want from us, and in June we kick off a magazine that will deliver it.

Don't panic, though. The things you like about the present *Microcomputing* will still be there. You'll still find Frank Derfler's "Overview" column, Mark Robillard's "Techniques" column, the latest in new products and new software and timely and thorough reviews. Basically, the new *Microcomputing* takes the aspects you like about the magazine and multiplies them.

We also have a few additions to the magazine that we think will "blow your socks off." We're launching three new columns that will help to provide information on advances in the ever-changing micro world.

"The Database Manager" will cover the fast-growing database management market. In the words of the column's author, Shawn Bryan, "The genesis of this column is a conviction by *Microcomputing* that at the heart of all we do with computers is information management."

Each month Shawn will report on what's new in the database management field, talk about problems you may encounter and offer advice and sanctuary to those who have lost their way.

"The System Prompt" takes you on a journey into the world of MS DOS and CP/M. Each month columnist Ed Joyce will address a subject of importance to anyone using (or thinking of using) either the MS DOS or the CP/M operating system. In the coming months, "The System Prompt" will cover public-domain software, the most frequently asked questions about CP/M and MS DOS, the annual CP/M convention and many other topics.

Columnist Phil Hughes delves into the intricacies of the popular Unix operating system in "The Unix Pipeline." Phil will cover the history of Unix, the basics of the Unix shell, the Unix file system, file security and protection and much more.

We'll highlight portable computers in our June issue, taking a close comparative look at five entries in the laptop sweepstakes—the Tandy Model 100, the Epson HX-20, the NEC 8201, the Grid and the Xerox 1810. Our technical editor, Jim Heid, has run the five through a series of benchmark tests and he'll pass on the vital facts concerning these leading laptops.

We'll also take our first close look at the Sharp PC 5000. This highly touted machine is finally available. Is it worth the wait? In June, we'll answer this and other questions about this new breed of portable computer.

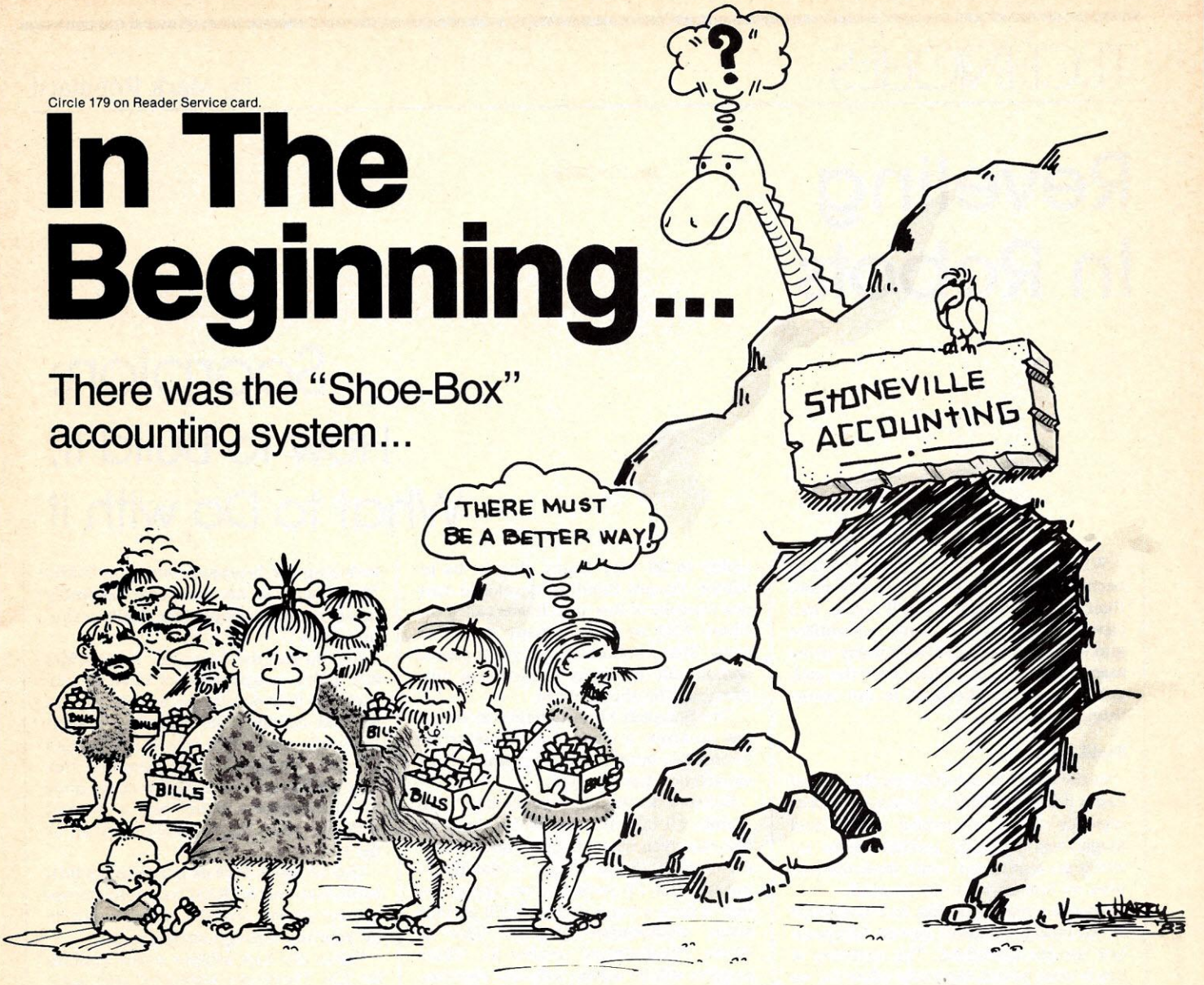
We also have some big stories in the works concerning hot portable computers about to be announced by some of the leading manufacturers in the business. We can't give you any details now, but in June we'll let the cat out of the bag.

Hopefully, this sneak preview has whetted your appetite for the new *Microcomputing*. Starting with our June issue, you'll find a banquet of articles designed to provide you, the advanced computer user, with a feast of information. *Mangia!*

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In The Beginning...

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By Mark Robillard

Reveling In Robots

Scorpion: How to Build It; What to Do with It

Where have all the kits gone? If you've been playing in the micro arena for more than just a few years, you'll notice, as I have, that most electronic assemblies and subassemblies available today come assembled. It's very difficult for the gadgeteer to satisfy the need to put something together.

Field Days

In the early days, hobbyists like myself had a field day. Today's computer stores typically stock assembled units, and magazines generally publish more reviews on assembled units than instructions on how to build one yourself.

There's a reason for this. As I mentioned in last month's column, certain things are best bought assembled. The economy of this is often sound, especially when the assembly isn't that expensive.

As some of you know, I'm an avid robotics nut. Whenever I'm not writing "Techniques" or working, I'm building, or planning to build, robots. Assembled robots are usually very expensive.

About a year ago, I reported on the Heath Hero-1 Kit. Now that was a kit that used everything I knew about how to build electronic assemblies! Sure, it had its frustrating moments, but it was very satisfying when I flipped the power switch and the robot responded with its first "Ready." A fifteen-hundred dollar price tag is a bit steep for many hobby enthusiasts, however.

It was early December when I first saw the ad in a familiar robotics magazine. Rhino Robots of Champaign, IL was advertising a small robot kit called Scorpion.

Let me share some history. Rhino Robots—originally called Sandhu Machine Company—came along a few years ago and introduced a kit arm for robot enthusiasts. It was fairly easy to put together and had most of the capabilities of the industrial arms of its type, except for the ability to lift very heavy objects. Its inventor, Harprit Sandhu, developed various versions of this arm. It was called the Rhino XR1 so the company name became Rhino Robots. A few years passed without the company announcing anything new for the hobbyist.

The Scorpion kit is different in that it has no arms. It can't manipulate its environment, but it does have some unique capabilities that I'll cover.

Before I do that, let me explain. This month, I'll take this particular robot kit and show you where to get it, how to built it and what it's like to use. In the following months, I'll present more theory on how it does what it does, and I'll provide some modification projects. This is where "Techniques" comes in. These projects will be usable with any electronic controller, not just with a Scorpion robot. However, if you have a Scorpion, you'll benefit more from the projects.

So What's the Big Deal?

What is Scorpion? If you look at Photo 1, you'll notice that Scorpion is a rather large aluminum box. Inside this box is the machine's intelligence. The two large drive wheels mounted in the front provide mobility on a flat surface. Sensitive bumper switches are located on all four sides to tell the robot when it meets an immovable object.

Atop the robot chassis is a motorized optical subassembly called a scanner. It consists of two stepper motors that enable it to move precisely in horizontal and vertical positions. A parabolic mirror concentrates the ambient light within the immediate area of the robot onto a sensitive photocell mounted at the scanner's center.

There is no power supply on Scorpion. You must supply the power yourself.

A Closer Look

Photo 2 shows the main parts supplied, including the Scorpion command board. This board is an electronic assembly based on the ever-popular 6502 microprocessor.

As you can see from Fig. 1, the 6502 has a full complement of devices connected to it. In one corner, an 8Kb by 8Kb EPROM contains the operating system that turns a box with wheels and motors into an intelligent, programmable motion platform. The EPROM commands the microprocessor and lets it interact with the other I/O devices connected to the bus.

One of these devices is a 2Kb by 8Kb RAM. Some of this RAM is used by the operating system and the rest is available for your use through an interface.

Notice the four stepper motor controller ICs. These are semi-intelligent logic blocks, built by Sprague Semiconductor, that provide step pulses in the correct sequence to the four stepper motors within Scorpion.

Also on the card is a converter that takes varying voltage signals, which come from a resistive divider that comprises a fixed resistor and the photocell at the vertex of the parabolic mirror. The converter changes the voltage variance into digital values that the microprocessor can read. In this way, the scanner becomes a sophisticated electronic vision system. A programmable UART provides RS-232C serial communications with your host computer. By "host," I mean that you control Scorpion by sending it commands. Scorpion doesn't have the ability to work all by itself as part of its operating system. You give it one command at a time, and it then performs that command. It's also possible, however, to gang commands and send them all at once. You can, for instance, program Scorpion to move in the forward, reverse or turning directions while its scanner is scanning the horizon.

Getting back to the block diagram,

you'll notice a ground tracker system. This tracker system consists of two incandescent light bulbs, which shine from the bottom of the Scorpion chassis, and two sensitive phototransistors and circuitry to provide logic outputs from the bulbs. These phototransistors make up a crude vision system for following patterns on the floor (such as reflective tape used as a track).

A tone generator is built in, as is a circuit to control two LEDs up front as eyes. Why do you need tones and eyes? It's important to provide some sort of human interface to make robots a little friendlier. You can program the speaker to blast out at many frequencies and frequency durations. You can use it to signal that the robot has bumped into a wall. The eyes add a little more personality. They can blink separately or together, or turn on or off.

Also available on the card is an area for another programmable interface element that provides you with another 32 I/O lines. These lines go directly to a connector that isn't used on the card. You can, therefore, use this as an expansion port to control many different types of devices. There are also empty places on the board for two more stepper motor controller ICs to allow you to interface with two more motors. Perhaps you'll use an arm of some sort or maybe another scanner.

Two areas where you can solder 44-pin edge connectors are also included on the board. These edge connectors have signals already applied to them that match the old KIM-1 bus. The KIM-1, one of the early microcomputer kits, was very popular and had many add-on memory and I/O cards. Scorpion allows you to plug in any of these cards or to design your own. I'll get into that in the coming months.

What's It Like to Build?

So much for the block diagram. What's it like to build the Scorpion? Where can you get one and how much does it cost? First of all, Scorpion costs $660. Is this expensive? That depends on how you look at it. Hero-1 costs $1500 and requires a tremendous amount of manual labor. Scorpion is much smaller than Hero and has much less functionality.

However, for less than $700 it gives you an accurate, programmable motion platform. Hero-1's motor and its motion subsystem are inaccurate, and you can become frustrated programming it to maneuver around a room. Scorpion, on the other hand, uses stepper motors to provide power to the wheels. Each motor moves one precise step per pulse. In the Scorpion command language, you tell it just how many pulses to move before stopping.

What are you getting yourself into? Well, this isn't a kit for beginners. It would be a kit for beginners if the documentation were expanded. The manual supplied with Scorpion, although complete, isn't written for the novice.

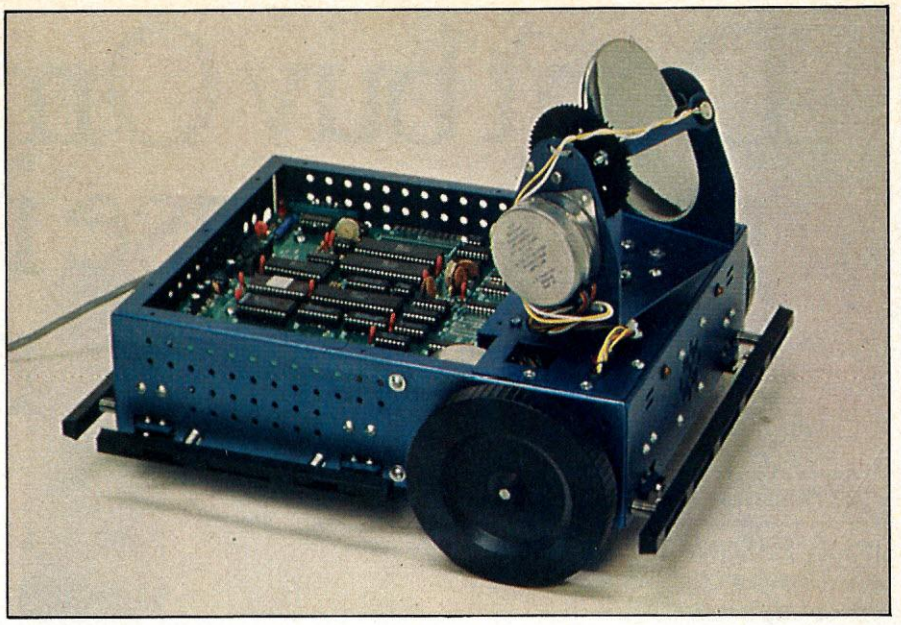


Photo 1. The entire assembled Scorpion robot.

You'll have to read a complex schematic diagram in order to connect portions of its electronic circuitry. The diagram looks like it was drawn on a larger sheet and then reduced to two pages. In the process some information, like voltage levels at certain points, was lost.

Mechanically, building can be somewhat nightmarish. Be ready to determine how to put things together by looking at a photograph of a completely assembled unit. There's a fairly detailed mechanical drawing within the documentation; however, you must be able to read a typical industry assembly drawing. The views shown may be a little confusing to the regular reader. Not all information is on the sheet, and the sizes of things aren't shown to scale.

You won't find explicit step-by-step instructions in the manual. If you're an experienced builder, you can probably handle it; if you're not experienced, take your time and find somebody to help you.

Why am I going to base my columns of the next few months on extending a machine that's hard to put together? I didn't exactly say it was hard to put together; I just said it'll take some patience. The machine you end up with is worth the patience.

After a few frustrating nights of putting together the mechanical subassembly and wiring up things that weren't called out in the manual, I plugged in the printed circuit board.

The power supply is the next problem. Microprocessors use 5V, but robots use motors and motors typically require more than 5V. Scorpion requires 12V. Many micros also have 12V supplies, but what might throw you is that Scorpion requires 12V at 5A!

After going through many power supply catalogs, I've concluded that the 12V, 5A power supply has gone the way of the dinosaur. There are many combination 5V and 12V supplies on the market, and some 12V supplies provide up to 3A, but none provide 5A.

What to do? Try batteries. You'll really be surprised at the current capabilities of standard lantern batteries. I picked up four super heavy duty lantern batteries, the kind with the screw terminals on top. Connecting these in series and parallel to provide 12V at twice the current capability provides enough power for Scorpion's motors and electronics.

Powering up the unit for the first time was a pleasure. I connected it to my RS-232C-equipped computer and sent it a command to turn on the eyes. It actually worked! From there, every command I tried worked and my frustration drained away quickly. Now let's look at what it can do.

What Can It Do?

Table 1 is a list of the commands, and their syntax, that Scorpion responds to. I'll go over each command now, but first, remember that the Scorpion's 6502 is constantly looking at the serial port. The serial port (the UART) is now connected to your personal computer or to a standard ASCII terminal.

When sent command bytes, the Scorpion responds by performing whatever action you ask. A command is denoted by an ASCII slash (/), which tells the Scorpion a command is coming. The next character in the command represents the number of characters the command requires. This tells the Scorpion controller how long the instruction is. (After the last character in the instruction is received, the command is carried out.) No carriage return is required. What you see in the list in Table 1 is exactly what it takes to perform a command.

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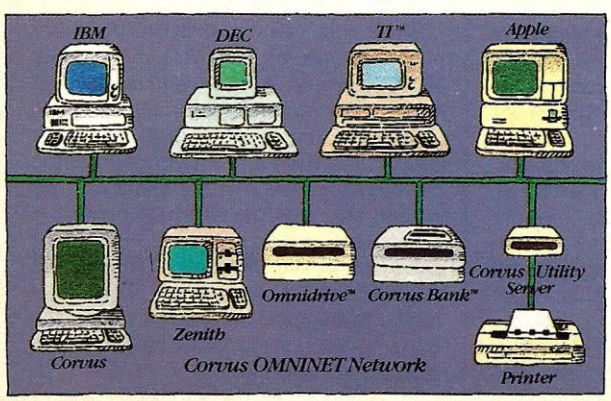


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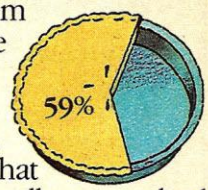
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The first command starts both drive motors. You're telling the robot that the command is seven characters long. The first character is an M, a "motor move" command. The next three characters are the speed and the direction. You'll notice in the syntax in the table that there is a plus sign shown on the first command. This can be a plus or a minus, with plus being forward and minus being reverse. The next two digits are the speed at which the motor should be moving. The last three digits, are the speed for the next motor.

The first three characters denote the speed and direction for the left motor; the last three characters are the speed and direction for the right motor. There are no units or distances denoted in this command. It simply tells the motors to turn on and move at a certain speed. The speed bytes are programmable in that you can go from very slow (one step per second) to very fast (all the way up to 100). Some of these shouldn't be used, especially the faster ones; you'll find that the motor simply oscillates if it's going too fast.

The next two commands separate the right and left motors. If you want to move one and not the other, these perform the same function as the first command, but denote one motor only.

Now I'll discuss the scanner, the item that made me buy the kit. After working with robotics for a few years, I've found that building a vision interface isn't an easy task. Having the mechanics already in place helps out tremendously. The mechanics provided on Scorpion consist of two stepper motors. Fig. 2 shows some details of the scanner and will give you an idea of the scanner's movement capabilities and of its general construction techniques.

Each stepper motor is programmed using the scan commands. There are two such commands. One moves the horizontal section and one moves the vertical section. Unfortunately, you can't do a horizontal and a vertical scan at the same time using the built-in command set.

What happens when it scans? Well, jump down the command list to the "do a horizontal scan" command. This command consists of four characters after the slash. HS denotes horizontal scan and the next two characters denote how far the scan should go. If, for instance, the number is 15, the scanner moves 15 steps to the left. Then it reads one brightness value into the scan buffer. Next it moves one step to the right and reads the next brightness value into the buffer. The scanner continues until it has done this 30 times. Actually, it's done 31 times because the scanner takes a reading at the center "home" position as it goes by. It then moves back 15 places, which puts it facing center again. To recap, a horizontal scan of 15 scans 15 places to the left, 15 places to the right, then the scanner resets itself.

What is the scan buffer? It's memory—part of that 2Kb by 8Kb RAM. You can read the scan buffer, as you can see in Table 1, from the robot. In reading the scan buffer, you'll get an output that looks like Fig. 3, which shows what was displayed on my screen when I scanned the room around my computer. It's also possible to scan vertically, and the two scan commands may be used during any movement command. The multitasking nature of this equipment makes programming easier for a robot hobbyist. The scan buffer output shown in Fig. 3 can be manipulated by your computer and displayed on the screen as varying brightness levels or colors.

This is one of the experiments I'll try to do in the upcoming months. I'll also be developing a language that allows you to control Scorpion using English commands instead of the slash, numbers, pluses and minuses. Of course, the language will be computer dependent, and space limitations will preclude printing routines for everybody's computer. However, I'll try to show some conversion techniques.

Command Close-Up

Looking back at the list, you'll see two sets of instructions—those that don't get feedback from the robot and those that do. Rhino calls the ones that do "questions".

Now let's examine the first part of the instructions—the ones that don't give any information back. I've already covered the drive motor commands and the horizontal and vertical scan commands.

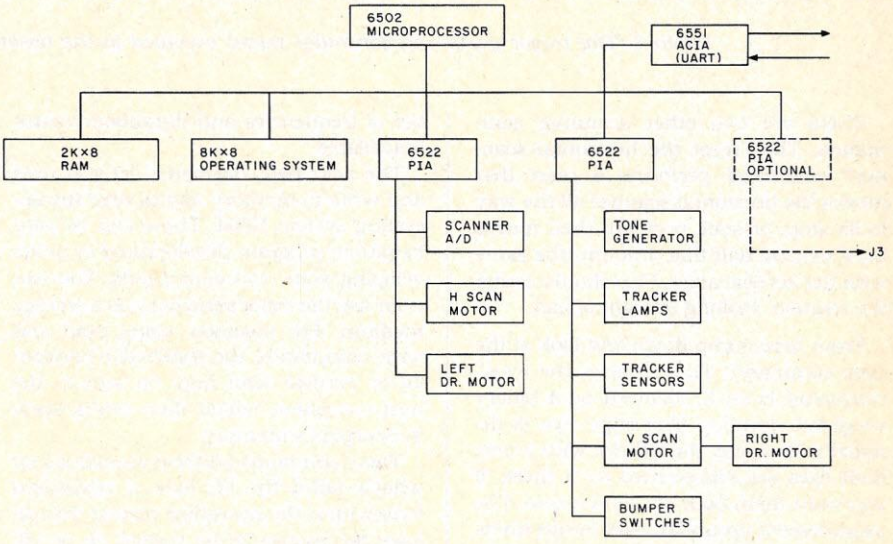


Fig. 1. Block diagram of the Scorpion controller board.

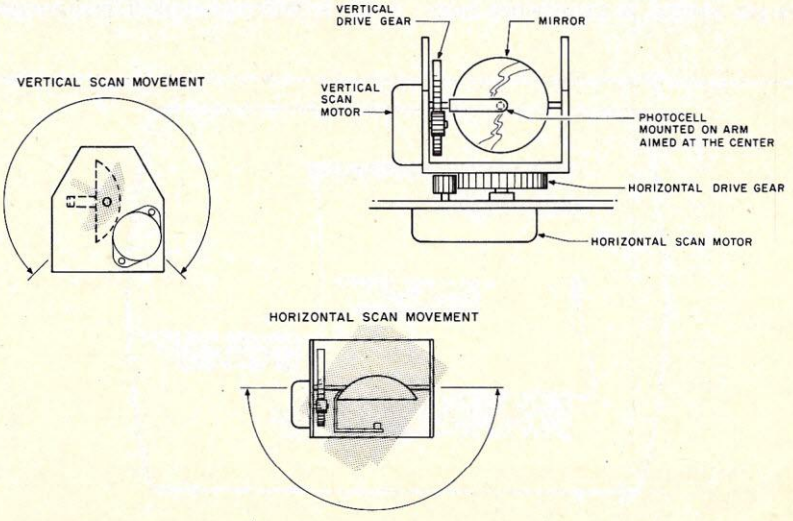


Fig. 2. Representation of the optical scanner mechanism.

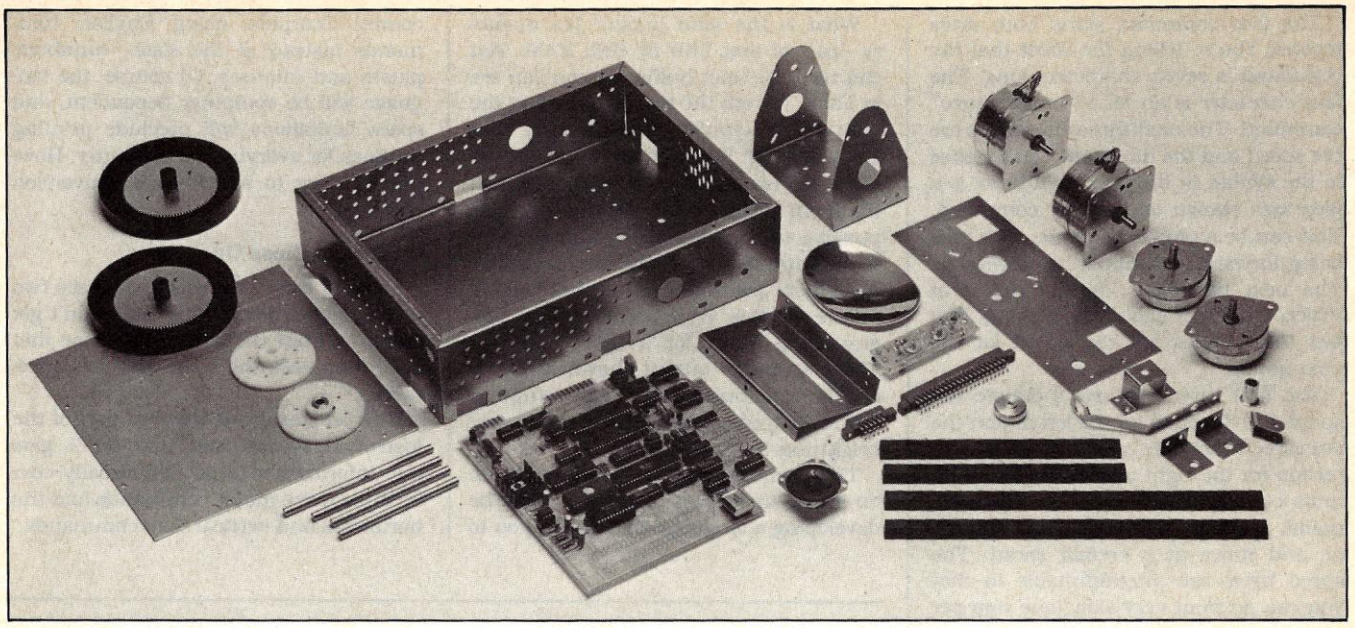


Photo 2. The major parts and controller board involved in the assembly of the Scorpion robot.

There are two other scanning commands. The "reset the horizontal scanner" command performs a reset that moves the horizontal scanner all the way to its stop, or stall, position, then moves back exactly half that amount (the same with the vertical axis). This should center the scanner, looking straight ahead.

From here, jump down and look at the eyes command. The "control the eyes" command is an E, followed by a binary weighted number. The right eye is denoted with a one, the left eye with a two; both eyes are represented by a three. If you want them both off, send a zero. The incandescent ground-tracker lamps (mentioned earlier) may be turned on or off by the G command.

The beeper, which is controlled by frequency and duration, is the next command on the list. The frequency variation is set in the factory at certain jumps in cycles per second. A tremendous number of frequencies and durational values is available.

The next two commands let you read and write to memory and to read the operating system ROM. These can be very helpful in program development or in developing your own commands. You can even use the robot's memory as a storage medium. For instance, using read and write commands, the results of a horizontal or vertical scan may be sent to the host computer, which then stores them in Scorpion's memory.

Two commands perform operations on what's called the I/O byte, a command byte within the operating system that allows the motors to be turned on or off. When the bumper is activated during movement, it automatically shuts off the I/O byte, which stops the motors, the scanner and the eyes. Each bit within the I/O command byte represents a function within the computer. You might look at it like an interrupt mask. If there is a zero in any one of those locations, the function that corresponds to it can be performed. If there are all ones within the byte, nothing is performed. You may ignore this mask using the "ignore I/O byte" instruction. The last two instructions in this list are the specific move instructions. You can move each motor plus or minus 9999 steps. This allows the Scorpion to move up to 40 feet in either direction.

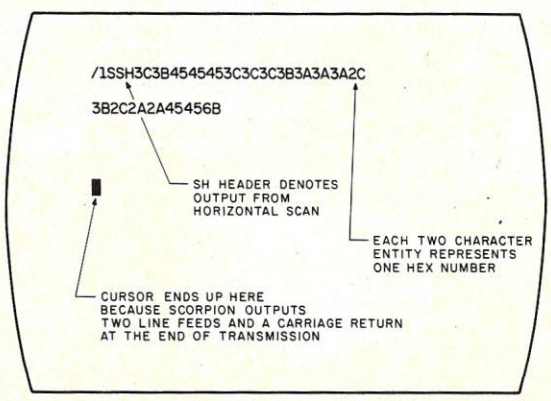


Fig. 3. A typical screen output as a result of the /1S command.

Feedback

Now let's look at the instructions that provide feedback. All four sides of the Scorpion have bumpers. Each has two microswitches connected to it. These microswitches each have a corresponding bit in a bumper status byte. That means that there are eight locations around the robot that can be interrogated to determine exactly where it's contacting an object. This information comes back as two ASCII characters that denote a hex byte.

Another command lets you determine which eyes are on. You can also check the status of the ground lamp and tracker. Remember that the tracker comprises two phototransistors mounted on the robot's underside that receive reflected light from the incandescent ground-tracker lamps.

The next command determines motor move status. The motor move status gives you the number of steps the motors have moved since the last time you checked. This gives you an on-the-fly reading of the robot's location. You can also read each individual motor as to how many steps it has to go after you've given it an instruction to move a certain amount. These three instructions are very similar and let a host computer track the exact position of the Scorpion.

The I/O byte that you command by turning the different motors on and off

can be read with the Y command. The "busy" byte, the X command, allows you to read the status of execution in progress. This tells you whether the speaker is busy, if at least one eye is on, if the ground-tracker lamps are on, whether the horizontal scanner or the vertical scanner is moving or whether anything else is going on.

Last but not least is the "read all parameters" command, which allows you to get all the information back except for the scanner buffer. In one instruction, this allows you to interrogate the position, the movement and the status of all of the robot functions.

Well, I've been rambling on a bit about this robot and what it can do. It's very hard to read a review such as this and get the actual flavor of what it's like to use this product, or any other product for that matter. The best thing to do is to go out and buy it. If you can't buy it, maybe you can get together with a friend and both of you can chip in. One can do some hardware additions; the other can do some software. Maybe your local computer club can buy one and then all of you can share in the upgrading of this basic system.

The only problem I've had to date using the Scorpion is the fact that the gears on the stepper motors tend to slip when they are driving the wheels. There are two ways that you can prevent this. One is to epoxy down these gears, which simply slip over the shafts of the motors, or you can actually drill a small hole through the gear and the shaft of the motor and insert a set screw. I have also noticed that the robot does not move extremely quickly; it tends to crawl. So, this may be a limitation or it may be something that I'm doing wrong. The next few months should tell.

Beyond This Month

Where do I go from here? Well, if you're not a robot enthusiast, don't worry. Next month I'll be covering remote control. How does that apply to robotics neophytes? Well, I'm going to show a circuit that will allow you to send RS-232C information over the airwaves. This interface will allow simultaneous transmit and receive commands to go through the air and connect to whatever you're trying to remotely control. If you're a robot enthusiast, I'll show you how to hook this interface to Scorpion. This will basically cut the cable, as long as you're using battery power. I'll also show those of you with a Hero-1 robot how to hook it up to Hero and provide you with some software information that allows you to enter in commands through the output that comes from the remote control box.

The following month will be the software month—I'll show you the English language-to-Scorpion commands compiler. This, of course, will only pertain to Scorpion users. However, the compiler is written in Basic and should teach all of you a little bit about designing an interpreter.

Until then, keep those letters coming with ideas for further series. Once again, I apologize for the less-than-speedy replies to your letters as I am inundated each month. I'd like to thank Ken Perry and Ellen Handler of Rhino Robots for their help in providing photographs for this article. □

Mark Robillard is a electrical engineer/program manager for Sanders/Calcomp in Hudson, NH. He can be contacted at MJR Digital, PO Box 630, Townsend, MA 01469.

Instruction Sequence	Description
/7M+##–##	Start both drive motors
/4L–##	Start left motor
/4R+##	Start right motor
/2HR	Reset horizontal scanner
/5HM–##	Move horizontal scanner
/4HS##	Do horizontal scan
/2VR	Reset vertical scanner
/5VM+##	Move horizontal scanner
/4VS##	Do vertical scan
/2E#	Control eyes
/2G#	Control ground trackers
/5Sffdd	Sound Tone at freq (ff) and duration (dd)
/7Waaaa##hhhh . . .	Write to RAM at aaaa with ##
/7Raaaa##	Read RAM or EPROM at aaaa
/1R	Reset system to power up condition
/3Yhh	Set I/O byte (condition mask)
/3Zhh	Ignore/obey I/O byte
/8C+#######	Move left drive motor a specific amount
/8D–#######	Move right drive motor a specific amount
Answer Instructions	
/1B	Return bumper status
/1S	Return contents of scan buffer
/1E	Return eye status
/1G	Return ground lamp status
/1T	Return ground tracker status
/1M	Return motor move status
/1Y	Return I/O byte condition
/1X	Return busy byte status
/1C	Return steps to go status for left drive mt
/1D	Return steps to go status for right drive mt
/1P	Return all status of robot

Table 1. List of the commands available in the Scorpion robot.

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By Frank Derfler, Jr.

Micro History Repeats Itself

Tuning In To Radio Software

This month, I'll examine the trend toward multi-user microcomputers. I'll also discuss a unique method of sending software through the broadcasts of commercial radio stations.

Watching the Wheels

Many philosophers have noted that history repeats itself in an unending cycle. Some portions of the cycle assume a slightly different form each time they appear, but the substance of the old is always contained in the new.

In the beginning of the age of electronic computing, the number-mashing machine did only one job for one person at a time. Slowly, as the power of the processor grew, we learned how to divide its activities between the tasks required to serve several different people. Of course, the processor still did (and does!) one particular task at a time, but it was able to work on small portions of different jobs while its external storage (tapes and disks), printers and other peripherals were responding to commands. This procedure of sharing the time of the processor makes it appear that the computer works on several tasks simultaneously.

The way our computer systems were built was decided in large part by economics. All computer hardware was expensive, so it had to be shared between many users to be economical. Over the last ten years, the price of semiconductors has dropped dramatically, reducing the cost of processors and memory. At one point, this created a period of temporary economic insanity. We decided that we had to share expensive electromechanical devices, such as disk drives and printers, as we established those ridiculous word processing pools. The economics of word processing pools was valid for about a year, but the turmoil they caused in many offices still lingers on.

The reduction in the prices of disk drives and printers, following the reductions in the prices of semiconductors, led to the practical personal computer. You can't have a practical personal computer without economical peripherals.

As I explained in my November 1983 column, this trend toward smaller and less expensive systems will continue until we again commonly have a sophisticated computer dedicated to only one job. Many consumer electronics items now have internal microprocessors with extensive programming in ROM. Modern automobiles contain several computers dedicated to tasks such as regulating the engine timing. The low cost of processors and memory devices support and encourage this type of dedicated computer arrangement.

But now history is starting to repeat itself again. I can see a trend back toward the multiple use of centralized systems. The driving factors are slightly different than they were in the late 1950s, and the configuration of the multiple-use systems reflects the hardware available, but the trend is clear.

Altos, Convergent Technologies, North Star and other manufacturers are finding good markets for their computer systems that enable several users to gain access to the same pool of data files. Local area networks connect users together and give each of them access to large database storage systems. The motivation behind the growing popularity of small multi-user systems isn't strictly economic. The motivation is more modern but just as compelling. The motivation comes from



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Controlling the access to and accuracy of information stored in computer files has become an important priority for many corporations and institutions. It's difficult to make changes or ensure the security of valuable information when it's distributed on disk drives in many different machines. Many things done with computers require that several people have simultaneous access to the same data. This shared data often must be kept current on an hourly or even minute-by-minute schedule. Centralized data storage and retrieval is the only good way to have the security and validity needed.

Trends

If you look at the cycle of history and see the wheel turning, you can develop some practical guidance for the investor or business manager. In the short run, you'll see microprocessors being placed into everything from toasters to telephones—in fact, the trend will eventually become ridiculous. But in the long run, the economics of information will drive companies, governments and institutions (the people with real money to spend!) to multi-user systems. Each person will have a machine like one of today's typical microcomputers as a terminal, but the major source of data will be centralized. The centralization of data storage will grow along with the decentralization of processing.

So, if you're a professional data processing manager, you should buy both your corporate PCs and your big computers with an eye toward communications capabilities. The big machines are going to have to be ready to talk to many small machines simultaneously. If you are an investor, you should look into offerings from companies like Convergent Technologies, Altos and the aggressive local area network company that just went public, 3COM. You should investigate my least favorite operating system, Unix, to see if there's software available under this operating system to meet your needs. Watch for AT&T to enter the market because they'll certainly sell multi-user systems with the Unix operating system. Even IBM will get into the multi-user game soon.

The circle of life turns surely. In the area of computers, it's moving faster than in many other areas, but its path is not difficult to predict. The trick is in knowing which way to jump when you see the wheel rolling.

Portable Rams

By the way, while I'm speculating on trends, I discussed my experiences with kneetop microcomputers a few months ago and commented on the lack of adequate RAM in these devices. I recently received a press release from Intel describing their production of 64Kb CMOS RAM chips. CMOS technology is a method of construction that results in semiconductors with a low power drain. The practical battery-operated computers use CMOS chips, but previously they had only economical CMOS RAM chips with 8Kb storage. The high production rates for the Intel CMOS RAM should result in much more capable and affordable kneetop machines. A good price on these devices will also make memory boards that don't erase themselves when you turn off the power more practical. One of the nice things about using the Epson HX-20 portable is you can turn it on and be exactly where you were when you turned it off. Wouldn't you like to have that capability on a PC with 512Kb of RAM?

PCjr Goes to School

In another recent column, I voiced my opinion that the PCjr was designed specifically to fit into the classroom. A recent press release from IBM describes their program to give away 12 million dollars worth of PCjr systems to 26 urban school systems. Even at full retail price, that is a lot of computers! Many companies have bragged of sales in that price range, but IBM is giving the systems away.

Hmmm, sounds like a darn good way to get a captive audience you can use to test and refine software. Twelve million dollars is a small price to pay to get back the firm grip in the educational market that IBM once had. Apple has sold a lot of Macintosh machines to colleges, but IBM will get 'em while they're young . . . in color.

Downloading for Dollars

The Microperipheral Corp. was an early entry in the data communications market. They made modems for the early TRS-80 microcomputers that allowed the Radio Shack systems to communicate over telephone lines despite the lack of a serial port in the machine. They've always been an aggressive company with the talent and flexibility to explore new ideas.

Now, the creative folks at Microperipheral Corp. have hit on a new idea that sounds like it's both fun and profitable. They have developed a system for practically transferring software to individuals through the use of commercial FM and AM radio and cable television services. Using the inexpensive Microperipheral device, you can hook your computer up to your Sony Walkman (or any radio with a headphone jack) and receive software that you can then run in your

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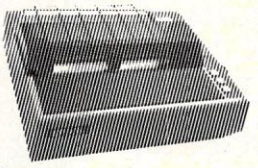
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computer and save for reuse.

The key to this system is a special receive-only modem that is both inexpensive (about $70 retail) and fast—300 to 9600 bits per second (bps). In case you're not a regular reader of this column, a modem converts the weak electrical signals in your computer into some other form that can pass over telephone, radio or coaxial cable systems. The Microperipheral Corp.'s AM/FM Loader is a specialized modem that uses a special method of encoding data for transmission on commercial radio stations.

The receiving device is simple to install. One cable plugs into the audio output jack of a radio. Another cable, terminated in a standard DB-25 cable, plugs into the serial port of the computer. Power comes from a common 9V transistor radio battery.

One commercial radio station, KMPS in Seattle, has been transmitting computer programs by radio since March 1983. The broadcasts are normally made during the night when few people are listening. People interested in receiving the computer programs can record the radio station and play back the recording through the AM/FM Loader so they can capture it in their computer.

A Growing Base

The commercial concept behind this product is based on the growing number of microcomputers in the country. The large base of microcomputers means that it's possible to identify a large radio audience with specific interests. This audience is perfect for certain kinds of companies that like to sponsor a radio program aimed at computer users. But to draw these special listeners, you need something more than chatter about computers. If you can give the listeners something special to use in their computers, you'll capture and hold their attention. But there are some technical problems involved in transmitting data over commercial stations.

Most common modems are designed to both transmit and receive data simultaneously. The two-way requirement means that transmission in each direction is slower than it could be if transmitted one way at a time. The AM/FM Loader is a one-way device. It can receive data at speeds up to 4800 bps over commercial radio stations and up to 9600 bps over cable television channels. At 9600 bps, you can capture a typical video game in less than four seconds. Various business arrangements could allow listeners to buy the AM/FM Loader at the normal price, make the devices available through coupons or as loss-leaders at a lower price, or give them away as a bonus with certain purchases.

The programs to be transmitted can come from the large base of software that's publicly available through various user groups, from software companies that have created demonstration versions of their programs, and from programs that are specially purchased for the purpose of broadcasting. The broadcasts can simply be a part of short commercial spot announcements or parts of longer radio programs that have a talk show format.

The Microperipheral Corp. has some work to do. They have to sell the concept of transmitting software to radio stations and sponsors across the country, but these people should readily accept the idea. No other technique reaches a specialized radio audience as well. So, if you hear some strange sounds coming out of your radio, it may not be the latest punk rock group. It may be the latest version of a word processing program coming your way.

If you're in the broadcast industry and interested in this method of reaching a special audience, contact Michael Darland at the Microperipheral Corp., 206-881-7544.□

Contact the author at PO Box 691, Herndon, VA 22070.

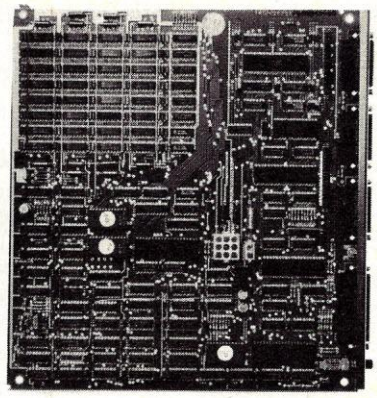
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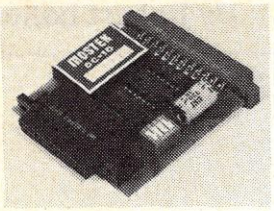
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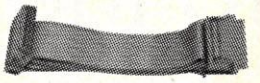
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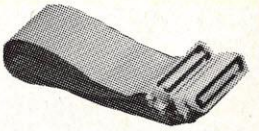
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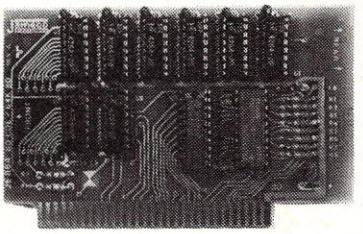
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Circle 41 on Reader Service card.

By Robert Baker

New Additions To the Family

Commodore Launches a New Line of Products



The Commodore-264 is the newest addition to the Commodore family of home computers.

Commodore Ships New Line

Commodore introduced a new family of computers and peripherals and an impressive array of software at the Winter Consumer Electronics Show (CES) in Las Vegas in January. In the coming months you'll hear much more about the new Commodore-264, 364, and V364 systems. The SX-64 is now being shipped and you'll see the new MCS Model 801 color printer along with the Magic Voice module.

A new term you'll be hearing from Commodore is "built-in software." The main theme of its 35 new software products is built-in software or software on a chip that can be put in a cartridge or can be built in the computer system. Talking software is available for both games and business packages.

Since 1977 when Commodore introduced the first PET, it has not discontinued any computer line. The PET and CBM computers sell at a higher rate now than in 1977. For that reason, Commodore has no intention of discontinuing older products when introducing new products. It intends to support these products as long as consumers want to buy them.

The Commodore-264

The Commodore-264 line of home computers adds multiple models to the current VIC-20 and Commodore-64 products. The new 264 line offers several models with built-in software and basic capabilities strengthened by these features:

- 64Kb RAM, with 60Kb available for Basic programming
- Full typewriter-style keyboard
- Optional built-in software
- Screen window capability
- Help key
- Eight programmed/reprogrammable function keys
- Four separate cursor keys
- Compatibility with most C-64 and VIC-20 peripherals
- 128 colors (16 primary colors with eight luminance levels)
- More than 75 Basic commands
- High-resolution graphics plotting
- Split screen text with hi-res graphics
- Graphics character set on keyboard
- Keyboard color controls
- 320 by 200 pixel screen resolution
- Reverse and flashing characters
- Two tone generators
- Built-in machine language monitor

The new 264 product line is a logical addition to the current VIC-20 and C-64 family of computers and should appeal to a broader spectrum of consumers. The VIC-20 is an ideal starter computer, while the C-64 is a versatile, general-purpose computer to use in the home, office or school. The new Commodore-264 series offers full-featured applications computers with an emphasis on simplified programming, graphics and built-in productivity software. This is useful for the serious home user, the writer, the financial analyst and the small-business operator. The new model should be available in late spring or early summer.

Built-In Software

Commodore is offering its most popular personal computing applications as built-in software options for the new Commodore-264 personal computer. Several models will have different built-in software packages. Although Commodore hasn't announced specific titles for most of the software, built-in applications focus on personal productivity. More than 30 Commodore software products will be available on cartridge, disk and tape when the 264 goes on sale.

According to Commodore's Sig Hartmann, the key area Commodore is emphasizing is productivity, covering such areas as household mangement, word processing, calculation, business accounting and education. Commodore sees us in a "decade of increased productivity," and microcomputers like the 264 will make an important contribution by

helping us to do more in less time than ever before.

By choosing a Commodore-264 with a particular software package built in, you tailor the computer to your own needs. If you use your computer mostly to do word processing, buy the 264 with professional word processing built in. If you need financial calculation, buy a built-in electronic spreadsheet. Whatever you choose, you can still use standard software on cartridge, disk or tape when you need to do something else.

All software built into the Commodore-264 is also available on plug-in cartridge. For example, someone who buys a Commodore-264 with a built-in word processor can buy an electronic spreadsheet on cartridge, or vice versa. In addition, software for the Commodore-264 is also available on cartridge for the Commodore-64. With the application software on cartridge, you'll get more workspace inside the computer, making programs more convenient and powerful.

Productivity Software

Here are some of the various productivity software packages being introduced by Commodore. All of the packages will be available by late spring on cartridge and disk for the Commodore-64 and Commodore-264 systems.

Magic Desk II features integrated text editing, spreadsheet abilities, a file manager and a calculator for beginning computer users. Special help screens are built-in and pictures are commonly used instead of commands.

EasyCalc 64 and EasyCalc 264 are full-featured spreadsheet programs with color selection and graphics. Both versions are sold on cartridge, providing more working space within the computer than comparable disk-based spreadsheets.

Commodore B/Graph is an easy-to-use business graphics and statistics package for business people and students. B/Graph computes and converts financial and statistics results into colorful three-dimensional charts, graphs, pie charts, histograms and other graphics.

Financial Advisor is a sophisticated financial aid for computing loan, mortgage and investment formulas. It's available on easy-to-use plug-in cartridges.

Teligraphics provides videotext and graphics software for use with Commodore telecommunications modems. It allows transmission of pictures, text and business graphics over the telephone and between computers. Teligraphics also allows users to upload and download through telecomputing services like CompuServe and is compatible with the Canadian Telidon videotext standard.

Speech Module for the C-64

Commodore has developed true-to-life speech for the Commodore-64 series of computers. The speech module plugs directly into the user port of the Commodore-64 and contains an additional port into which other talking and nontalking cartridges can be inserted.

The Commodore speech module contains a built-in vocabulary of 235 words in a pleasant female voice. The voice speed is user-defined as slow, normal or fast. Words are programmed directly from Basic and/or assembler, and the user can program music, graphics and speech simultaneously.

The speech module supports a separate audio output so that the user can connect the speech output directly to a hi-fi system, a television or a color monitor. More words and different voices (male, cartoon characters and so on) will soon be available on disk and cartridge.

Future educational applications on disk and/or cartridge include learning the alphabet, counting, spelling and recognizing animals. Higher level applications include interactive foreign language modules, higher mathematics and science. Programs are available from Commodore and third-party producers.

Commodore's speech module is called Magic Voice and has a suggested retail price of $59.95. It also plugs directly into Commodore's portable computer, the SX-64, making it the only talking portable on the market.

Talking Software

Commodore has announced the release of four new talking software products for use with the new Magic Voice speech module. A talking educational program makes learning easier, and the use of speech in games adds to the fun. As a learning tool, speech is a valuable aid to young children who are learning the alphabet and learning to count. In fact, learning a foreign language from a home computer with speech capabilities becomes truly feasible.

Two educational programs combine speech with graphics and music to create learning aids for children. A Bee C's teaches children the alphabet, using the Commodore Bee to familiarize them with letters, letter order and pronunciation. Counting Bee teaches children to count in a similar manner. Both programs allow children to match what they see on the screen with what they hear to help them master pairing sight and sound.

Both Gorf and Wizard of Wor duplicate the phrases and tone of voice used in the arcade originals. In Gorf, players are verbally challenged and instructed by the Gorfian commander, while the Wizard talks to players in Wizard of Wor.

Each game has a vocabulary of more than 100 words and 20 phrases. When played without the Magic Voice module, the arcade games still have all the sound effects of the originals, except for speech. The games range in price from $30 to $40 each.

Commodore Leads in Telecomputing

Commodore has sold more than 100,000 modems during 1983, becoming one of the world leaders in units sold. A source within the company attributes this success to incentives such as free information network time and value. The VICmodem sells for less than $60; the Automodem is now priced under $100.

The large number of modem-equipped home computers has dramatically increased the use of telephone access to information service companies like CompuServe and has allowed for expanded operations. Commodore and CompuServe, for example, offer a special service to Commodore computer owners called the Commodore Information Network. During the last 18 months, this network has become the most active CompuServe special interest service. Current features of the Commodore Information Network include:

- Immediate access to technical tips, product descriptions, free software and a hotline service with user questions answered by Commodore staff experts.
- On-line computer conferences where experts answer questions from computer owners. Times and topics of these conferences are announced on the network bulletin board.

Vidtex

Commodore has signed an agreement for CompuServe's Vidtex terminal emulator, a telecommunications package that allows users to transfer programs from CompuServe's large library to their own systems. The nonexclusive agreement allows Commodore to sell, market and distribute Vidtex worldwide. In addition, CompuServe will also market the package directly through its dealer network.

The Vidtex package uses CompuServe's exclusive "B" protocol, which allows 100 percent error detection and correction of files to be transmitted to or from CompuServe. Vidtex even notifies the user if he is trying to download an incompatible program written for another computer.

Vidtex is a disk-based program designed for Commodore computers that use the Commodore VICmodem Model 1600 or the Automodem Model 1650. These include the C-64, CBM 8032 and the new Commodore generation of home and business computers, the C-264.

Micro Illustrator

Commodore has reached a worldwide distribution marketing agreement for rights to the Commodore-64 and 264 versions of the Micro Illustrator. Designed by Island Graphics, this microcomputer painting system has a user base approaching 100,000 units. It provides inexperienced users with the power to create graphics for entertainment, business, program development or artistic expression.

The Micro Illustrator is easy to use. The user selects various features from a menu of icons with either a joystick or

light pen. In fact, the user never touches the keyboard except to name a file.

Basic functions include the ability to draw freehand using a variety of brushes, colors and textures, and the ability to generate geometric figures such as lines, circles and boxes. A fill feature and a magnification mode enable the user to zoom in on a specific area for fine tuning.

The Commodore-64 version utilizes all 16 colors of the machine. The Commodore-264 version exploits the full range of 128 colors. Both versions use either the Commodore joystick or Commodore's new light pen. Pricing information is not available.

Outside Software Development

In the past, a number of the best-selling Commodore software products were produced by outside developers. These included EasyScript 64, The Manager, Logo, the Zork adventure series and the Bally/Midway game series. Commodore now works with more than 35 software developers, including Data 20, Digital Research, Infocom, InfoDesigns, Island Graphics, MicroPro, Midwest Software, Milliken and Tri Micro.

Commodore's emphasis on outside development has allowed it to concentrate internally on specialized areas, resulting in products such as Magic Desk and Magic Voice. Commodore computers now have more than 3000 software products in the market to support them.

New Line of Advanced Entertainment Programs

International Soccer is the first in a series of "Gold Medallion" games. The Gold Medallion designation is reserved for a special category of new game and adventure products that have advanced animation graphics as well as play action that demands thought and strategy.

International Soccer offers three-dimensional animation, realistic perspectives and authentic soccer play action for one or two players. It has a suggested retail price of $34.95 and should be available now. This is one of the most impressive games I've seen for the Commodore-64.

Future Gold Medallion releases will include a professional-level basketball game. Other entertainment programs include:

- Viduzzles, a series of video puzzles for children
- Jack Attack, an animated strategy game with many variations and levels of play
- Solar Fox, one of the best of the Bali Midway adventure games.

All of the new Gold Medallion games should be available for initial delivery in the spring.

Logo with Disk Storage

One major feature of Commodore Logo for the C-64 and C-264 is 170Kb of available disk storage. Other features include:

- Seven programmable sprites
- Music capabilities
- Picture saving
- Assembly language interface
- Arithmetic floating decimal point
- Program tracing
- Comment/remark capabilities
- Word and list commands
- Tutorials for graphics and word and list commands.

Commodore Logo lists for less than $80, and when packaged with the Commodore-64, a color monitor and 1541 disk drive, a full-fledged Logo system is less than $800.

100 Applications Templates

Commodore Software is introducing a series of applications template products for its C-64 Manager 64 database system. The templates include five to ten specified applications on each disk that let you computerize home budgets, index recipes, keep track of sports statistics, track business accounts and so on. Each application comes with complete documentation and built-in help screens.

The Manager, a sophisticated database program, lets you define your own applications. Four applications come with the Manager: Holiday Planner/Mailing List, Task Manager, Portfolio Manager and Home Checkbook. These applications make it easy for the first-time computer user to immediately take advantage of the capabilities of computerized record keeping.

Ready-to-use templates include the Home Manager, the Kitchen Manager, Sports Manager and the Business Manager. One hundred different applications are planned.

Typical of the applications templates is the Home Manager, which provides five different applications:

- Home Inventory organizes household effects for insurance and business purposes.
- Home Budget tracks your money each month. It comes with 15 predefined budget categories for each month with room for ten additional categories of your own choosing. A bar graph comparison of budgeted vs actual expenses is also provided.
- Birthday/Mailing List, an electronic address book, remembers what birthday gifts you have given for the past five years. It also provides a list in calendar order of birthdays, including actual ages.
- Garden Records keeps inventories of plants with date of planting and retains up-to-date information on soil mixture, fertilizer used and weekly crop yield.
- File Card is a computer index card that stores notes, recipes, important dates, names and addresses and so on. Each card has an optional title entry that makes searching for a specific card easier.

The Manager templates can be used by anyone. Once familiar with the application, you can add in additional features, such as new reports, with no extra programming. Standard capabilities of the Manager include colorful data entry screens, full search and sort capabilities, arithmetic calculations and a powerful report generator.

3-Plus-1 Integrated Software

Commodore offers fully integrated software for a home computer with 3-Plus-1, which includes a word processor, electronic spreadsheet, file manager and graphics package. All four programs are integrated in the same software product and work together sharing or swapping information. For example, a financial analysis created on the spreadsheet can be transferred to the word processor and incorporated into a written report.

Commodore 3-Plus-1 is offered on cartridge for the Commodore-64 and will be offered either as a built-in option or on cartridge for the Commodore-264 computer. It requires no computer knowledge or special experience and is designed for first-time computerists as well as experts. Applications include home budgets, business plans, sales forecasts, personal or professional correspondence, mailing lists, school or business presentations, electronic filing, "what-if" calculations, statistics and more.

The name 3-Plus-1 really describes the product. To the three types of productivity software—word processing, electronic spreadsheet and database file management—Commodore added a plus, which is business graphics, so you can visually represent spreadsheet data in chart or graph form. Windowing capabilities allow the word processor and spreadsheet to be viewed simultaneously.

Also, Commodore 3-Plus-1 is available on a convenient plug-in cartridge that allows more efficient working memory in the computer. On the new Commodore-264, it's also available as a built-in option as part of the computer's internal operating system.

Micro Cookbook

Commodore has a worldwide distribution and marketing agreement with Virtual Combinatics for exclusive rights to the Commodore-64 version of Micro Cookbook, a household management program providing complete cookbook and recipe management.

Micro Cookbook provides complete meal planning, including help in using leftovers. It comes up with recipes for a meal using the odds and ends in an understocked refrigerator or pantry. You're also shown how to combine supermarket specials into recipes. Other features include:

- 155 recipes, using a total of 165 popular ingredients with space to add 100 more favorites
- a glossary of cooking terms
- calorie and nutrition information.

Ten Educational Software Programs

The new educational software includes the Milliken Edufun! series, the Kinder Koncepts series and two new programs featuring the new Commodore Kids.

The Commodore Kids are a group of animated children and pets that help young users learn. The kids, which include boys and girls from various ethnic groups, debut in the Micro School series. This series, with such titles as Math Facts and Numbers Galore, is designed for elementary school levels and above. These programs are available on disk.

According to Dr. Kunz, director of educational software at Commodore, these programs are both teacher-tested and child-tested. A child can use these programs independently, or a parent can guide the child. More parents than ever are using computers to give their children a boost in learning at home. Commodore's goal in developing educational software is to produce high quality educational packages that teach, test and drill at affordable prices.

The Milliken Edufun! series was originally developed under National Science Foundation grants. The first releases in a series of more than two dozen programs from Milliken include the following: Glup!/Arrow Graphics and Frenzy/Flip Flop for the VIC-20, as well as Frenzy/Flip Flop for the C-64 for ages 7–12.

Each new product is actually two games in one. Glup! plays as a game and gives practice in addition and multiplication. On the same cartridge, Arrow Graphics tests visual and numerical problem-solving ability. Frenzy offers subtraction and multiplication practice in a game format, while Flip Flop tests visual problem-solving skills in recognizing differences between complex colored shapes. The VIC-20 programs come on a plug-in cartridge while the C-64 version is on disk.

Kinder Koncepts for the C-64 is a series of five disks totaling 40 programs for the 4–6 age group. Each disk contains four math programs and four reading programs. Included in the series are: Easy Count/Easy Math, What's Next/Letters or Numbers, A Letter Match/More or Less and Shapes & Patterns/Group It. The Kinder Koncepts programs provide practice for early math and reading skills and include parent guides.

These programs use music and graphics to encourage positive performance. The programs also record and display the child's progress on the screen, allowing you to monitor performance. Additional educational programs include Chopper Math and Type Right.

The Computer Book Business

Commodore is expanding its computer book business with a line of Bookware. This includes computer books, book and software sets and computer magazines.

Commodore has had tremendous success with its first two home computer books, programmer's reference guides for the VIC-20 and C-64. Every new computer introduced by Commodore will also have a programmer's reference guide, written by more than a dozen of their own in-house experts.

Commodore has worked closely with third-party writers and publishers. For example, the company's VIC-20 4 Book Pack, which includes four computer books in a boxed set, is provided by Commodore in conjunction with the Hayden Book Company. Individually, the books retail for more than $45 when sold by Hayden. Commodore has arranged to sell and distribute the books as a set for less than $25. Titles in the set include: *The VIC Revealed, VIC Graphics, VIC Games* and *Stimulating Simulations for the VIC*. Also, the Commodore edition includes the latest corrections and updates to the original books.

Another new Commodore Bookware product is a book and software set called *Mastering the VIC-20*, written by the editorial and programming staff of *MICRO* magazine. The set includes eight Basic programs on tape and a 191-page paperback book that explains various ways to write, edit and expand the programs. The concept is unique in that you can either use the programs as they are or study them to learn more about Basic programming.

Commodore is also developing a new series of products called the Programmer's Treasure Chest series. The new products will include books, software on disk or tape and reference materials, such as posters and reference cards. Programmer's Treasure Chest I, the first in the series, is available as of March 1.

Relax

Synapse announced a new line of personal healthware at the Winter CES Show designed for the C-64 and other home computers. The first product in this new line is Relax, a complete stress reduction system, which will be distributed on disk and cassette starting this spring.

Using bio-sensory technology, Relax lets you monitor stress levels by representing muscle tension graphically on your computer monitor. The Relax workbook, included with the hardware and software, helps you to understand your reactions to stress and also provides suggestions for managing and reversing those reactions. An audio tape guides you into deep relaxation, and when you use this tape in conjunction with the biofeedback mechanism, you'll be able to see and feel results. Relax also allows you to program subliminal messages that will reinforce your relaxation response.

The method is simple: just put on your Relax sensor headband. Three tiny sensors in the band provide highly accurate measurements of muscle tension. This bio-feedback method, called electromyograph (or EMG), measures electrical activity in the muscles. When you're tense, electrical activity increases. Of course, when you're relaxed, electrical activity decreases and your muscles lose their tension. Relax portrays this graphically on your computer monitor.

A control unit allows you to determine the sampling rate that you wish to use. A fast sample helps you discover your unconscious reactions to stressful stimuli, and a slower average rate gives you a general index of relaxation. Whatever setting you choose, you see the readings immediately on the screen. Your reading can also be printed out.

The Relax audio tape provides guided deep relaxation exercises that combine progressive relaxation with meditative techniques. The tape guides you through three tension relaxation games and also provides a list of hidden stress sensors, enabling you to be more aware of your own potential stress producing areas.

The Relax workbook has complete documentation for the program and helps you to understand and reduce stress. You can first create your own stress profile and then design a plan to help alleviate stress. Once you've made a plan, the Relax workbook provides guidelines for evaluating your progress over time.

The documentation and tutorial were written by Dr. Martha Davis, Ph.D., a clinical psychologist at the Kaiser Permanente Medical Center in Santa Clara, CA. A noted authority on stress reduction, she has written a number of books on the subject.

With Relax, you'll be better able to understand and reduce stress, minimize job burnout, control nervous habits like smoking and overeating and possibly even live longer, simply by learning how to relax. The first in a series of products from the new personal healthware division of Synapse, it's designed to use the capabilities of your home computer to help monitor and improve your health.

Odds And Ends

You may have missed out on a super bargain. Issue 16 (the Dec/Jan 83/84) of the *Midnite/Software Gazette* was a copy of the new book *The Best VIC/Commodore Software* published by the editors of Consumer Guide and written by Jim and Ellen Strasma.

The book presents concise reviews on more than 170 of the top-selling programs for the VIC-20 and C-64. The eight chapters cover word processing, business, home, education, networking, strategy games, arcade games and programming aids. The programs are rated on a scale of one to ten by various user groups across the United States and

Canada. The ratings cover performance, ease of use, reliability, documentation, graphics and sound and playability (for games). Comments are good and helpful in making the right choice.

For more information on the *Midnite/Software Gazette*, contact the publisher, Jim Oldfield, at 635 Maple, Mt. Zion, IL 62549. Subscriptions are $23 for six bimonthly issues.

More Info From ICPUG

I've been hearing about the Simons' Basic cartridge a great deal lately. Well, now there's something called BC Basic, written by Brian Candler. This Basic extension package is also available on cartridge at about the same price as Simons' Basic (in England). It has many of the features of Simons' Basic but none of the hassles. The commands are more thoughtfully constructed, and the package is recommended by ICPUG members. No mention is made of when BC Basic might arrive here in the states.

The latest ICPUG newsletter points out that variations between different SID chips are causing some problems in commercial software. The problems are in the filter section of the chip. The differences can cause filtered sounds on some C-64 systems to be inaudible or produce unexpected results. So avoid the use of the filter for software that's for distribution. Programs written and then run on the same computer should have no problems.

Anyone who does a lot of poking into screen memory on the Commodore-64 is well aware of the need to set the color RAM every time. Clearing the screen resets the color memory to the same color as the background and poked characters are invisible. This didn't occur on earlier C-64 systems released in the USA, so some programs don't take this into account.

One such program is the PET Emulator. When the screen is moved to start at 32768 instead of 1024 to simulate the PET screen, pokes to the screen should work, but they aren't guaranteed. The answer is either to rewrite the program so that every screen poke is accompanied by a color poke or reset the color memory every time the screen is cleared.

Be careful when using the 9V output of the user port. The manuals don't make it clear, but the 9V output on pin 10 *is not dc* with a ground on pin 11. In fact, pins 10 and 11 of the user port are connected directly to the incoming ac line from the transformer and are therefore balanced ac. Anyone connecting anything to this supply assuming that it is 9V dc is likely to damage the device and/or the computer. There is +5V dc available on pin 2, which should be adequate for most uses, but use caution.

New Books From Hayden

I Speak Basic To My Commodore-64 is a field-tested computer literacy course that introduces students to Basic language programming and the operations of a Commodore-64 computer. The course is the latest addition to the *I Speak Basic* series that explains the Basic language used by various home computers. The series includes a teacher's manual, student text and exam set for each machine.

The core of the course is the Student text that features learning objectives, definitions and examples of key terms and Basic concepts in class programming exercises, practices and assignments. Chapters cover Basic programming topics, such as mathematical operations, scientific notations, conditional and unconditional branching, input statements, loops, reading data, video display graphics, arrays and subroutines.

The teachers manual provides techniques for presenting the material and emphasizing particular concepts, annotations to aid in lesson planning, suggestions for implementing the course and answers to all practice exams.

The Exam set contains 12 quizzes on spirit duplicating masters to check student understanding and reinforce learning. The quizzes are easily reproduced for class use. A classroom set contains one teacher's manual, 20 student texts and one exam set and sells for $200. Separate copies of the student text are $9.75, teacher's manuals are $18.75 and exam sets are $15.

Commodore-64 Programs For The Home contains more than 40 Basic programs and is written for first-time computer users. The book incorporates program applications for games, educational tutoring and home financial management. A description of functions and operations is documented for each program. All programs are written for easy modification and have been tested on the Commodore-64. List price is $14.95.

Basic Commodore-64 Basic book begins with short computer programs that are easy to learn. Each program is divided into manageable segments, most fitting on a single screen. The book incorporates an explanation of special features and advanced programming techniques, such as the screen editor, immediate mode execution and graphics programs memory. List price is $14.95.■

This column marks the end of Bob Baker's PET-pourri series, but his Commodore expertise can still be found in our sister publication, RUN.

Address correspondence to Robert W. Baker, 15 Windsor Drive, Atco, NJ 08004.

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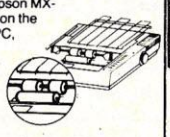
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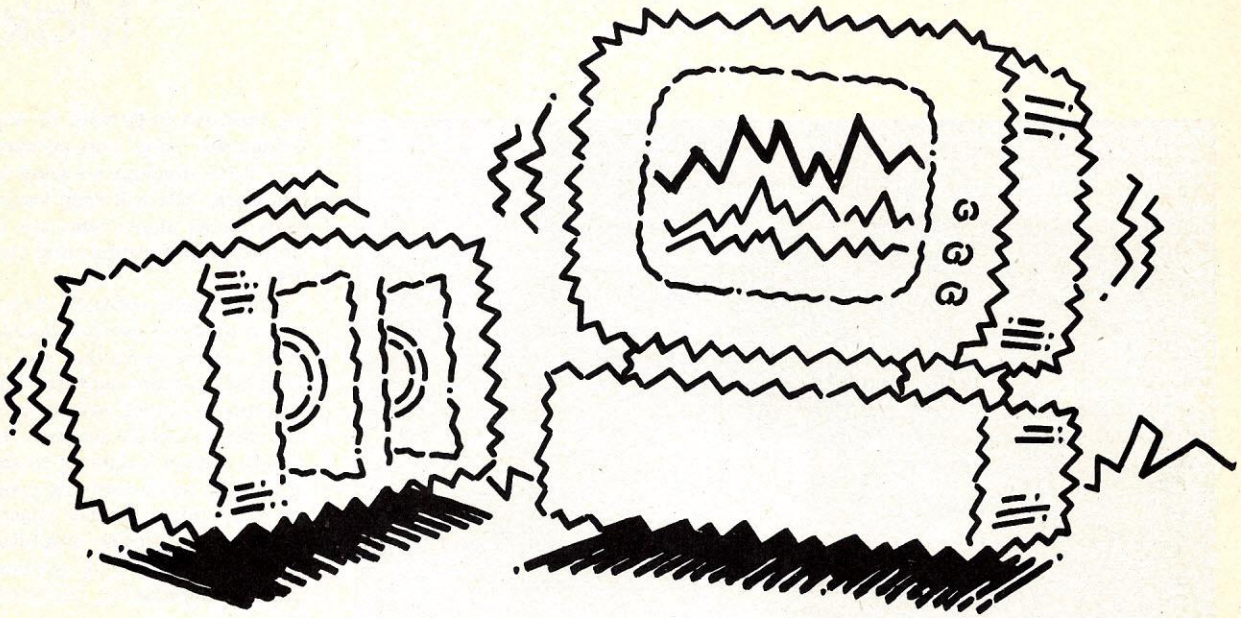
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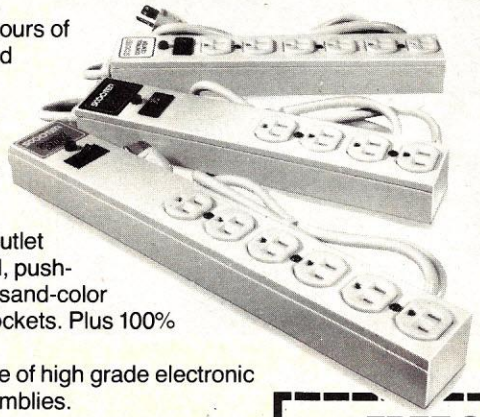
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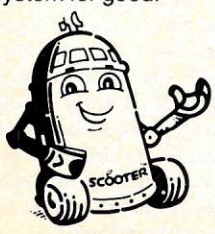
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WHAT'S NEW, BIG BLUE?

By Thomas Bonoma

IBM Takes To the Road

Can Mac Really Make It?

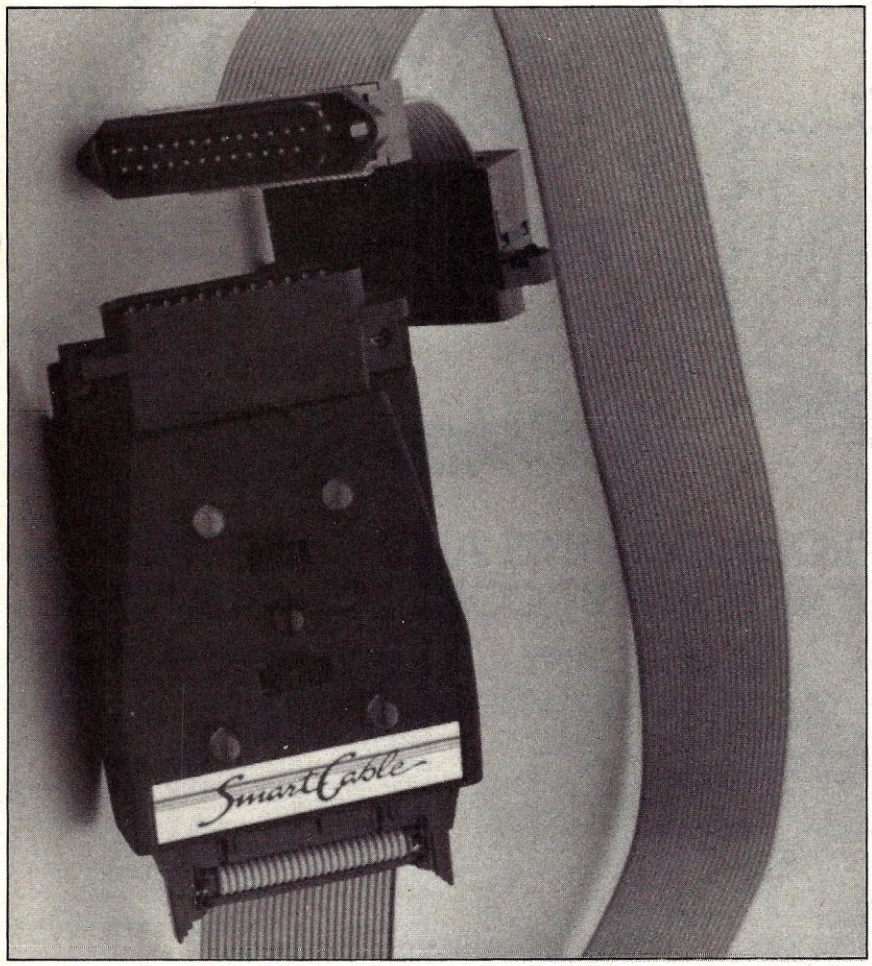


Photo 1. The IQ Technologies Smart Cable.

I'll share small bits of random speculation with you this month, before I look at new hardware and software.

What will it mean to the Compaqs, Hyperions and Eagles of the world now that IBM has announced a portable computer? No one will know for a while, I'm afraid, because word on the street is that the portable wasn't supposed to be announced when it was, but was pre-announced (contrary to IBM policy) by mistake.

IBM To Go

At some $2800, the machine won't be cheap once it's configured to do real work, but as long as it's DOS compatible and supported with 5¼-inch drives, it's hard to see how Big Blue won't carve out a major chunk of the take-along computing business to go with its work-at-work dominance and stay-at-home innovation. If the machine's a good one for serious work, IBM will keep busy supplying sales forces alone, who are hungry for simple, reliable computing power in the field.

Independent software developers I've talked to aren't overly excited about Apple's newest machine, the Macintosh. They say the development environment requires too much money in equipment for many small players, that Mac's 128Kb makes it difficult to shoehorn increasingly more complex programs into an increasingly smaller space, and that the absence of color graphics takes the punch out of lots of applications that might otherwise be transferred to the Mac.

I don't understand why the machine isn't PC DOS compatible, why it's not at least Apple II compatible, or why color graphics weren't offered as an option. These things, plus three-inch drives and the limitation of the machine to dot matrix quality printouts, make it a dubious candidate in my mind for either the business or home market.

While the Apple university give-away will punch up initial sales, the interesting thing to watch for will be the machine's staying power once the heavily discounted student programs have run their course. I hope Apple makes it. One-competitor markets just aren't very interesting or very responsive to customer needs. Let's see what happens when the smoke clears—I'm not optimistic.

Some hardware and programs I *am* optimistic about are reviewed this month, though. Two versions of the Select word processing system are attracting increasing attention in the field. A couple of good database managers that I want to tell you about have recently made their appearance (or reappearance). I'll also take a look at an integrated word processing, DBMS, spelling and even electronic mail program called The Ultimate. A number of other programs are reviewed as well. But now, for something really different. . .

Smart Cable

If you have any but the most standard peripherals attached to your PC, this story will ring true. You save for a year to buy a fancy new Yakamoto 10 printer with bidirectional something-or-other. You order it through mail order if you're an adventurer or go to your friendly, capable, competent dealer if you've ever tried interfacing a serially driven peripheral before. He tells you everything's fine, but when you connect that printer with the cable he sells you, it drops characters or, worse, won't print at all. Serial interfacing, given the complex terminology (DTE, DCE and so on), the nonstandard nature of the RS-232C standard and the do-as-you-please attitude of the manufacturers, is a continual nightmare.

Now there's a solution. Smart Cable, from IQ Technologies, Inc., is just that—a "smart" cable that costs no more than what you'd pay for custom cabling on that Yakamoto. It can be put on your shelf until you need it and, in less than a minute, allows you to interface any peripheral you've got to your computer (see Photo 1).

The device is just like a standard RS-232C connector, except it has both a male and female plug to connect the peripheral (how many times have I only had male but needed a female connector and vice versa?) and a set of red, yellow and green lights on top of the plug. All you do is hook up the peripheral to the Smart Cable and the Smart Cable to the PC. Then power up, move the top switch so that both yellow lights come on, move the bottom switch so that the switch points toward the illuminated green light and you're done! A configured peripheral! If the red light comes on, something is disabling data transfer, and you'll know to check bit rate or other settings.

Easy to Use

The instructions for using the Smart Cable aren't much longer than what I've described above—no foot-thick manual explaining CTS and ACK signals, just a friendly little brochure that says, "Hook it up and slide the switches." I think the Smart Cable is a marvel of ingenuity and recommend you have one on your shelf even if all your current peripherals are satisfactorily configured. The way the industry changes, it won't be long before you need a new printer or get a plotter. Imagine how much fun you can have when you say to the salesperson offering you an $80 custom cabling job, "No thanks. I'd rather do it myself!"

Review of Select and Select Write

Select ($295) and Select Write ($99) are two new word processors released by Select Information Systems. The former is the latest revision of the good Select word processor (version 3.0), upgraded by the addition of 28 new features and downgraded in price from $500 to $300. The latter is an innovatively packaged subset of the "big" version that will be sold through bookstores and other outlets for $99. Let's take a look at both of them in operation (I'm writing this on Select version 3.0).

Hey, Look It Over

The big Select is a competent screen-oriented text editor, formatter, merger and proofreader that is supplied on four single-sided disks, has a good reference manual, a "getting started" book and, important for learners, a programmed learning program called "Teach," accessible not only as a separate tutorial but also from Select's main menu.

Select's screen is relatively uncluttered, as Fig. 1 shows. The caret (>) on status line 1 shows that Select is a direction-oriented editor; you direct it forward or backward for all cursor moves, searches and replaces. Insert shows that Select is a mode-oriented word processor much like the good Pascal text editor. You can exchange, view (another document or disk directory), set pointers, replace, write blocks, justify, spell and do much more from this editing menu, such as select a special alter mode for program writing and other specially formatted text. The "you may use" business in the figure refers to characters (changeable by the user) Select uses in pairs to denote underlining, superscripting, emboldening, overstriking and so on. The second and third lines are self-explanatory. The rest of the screen is devoted to your text.

The editor itself works flawlessly and has good cursor movement routines. To move by word, you hit the space bar; by line (left side of screen only), the return key; by any other amount, either a punctuation mark (periods to move by sentences) or a number (e.g., 5), then one of the other commands (e.g., space bar) for a five-word move in the direction indicated by the caret on line 1.

Justification is automatic, though it occurs only after you leave the Insert mode and it takes a little longer than it should. All the normal commands work very well, but there's no provision for footnoting, hyphenation help (or even hyphenation) or movement to the extreme right of a line.

One of the best features of the editor is what are called "key" commands. These are macros, unlimited in length and unlimited in number, that you call into your file with two keystrokes. This feature allows almost unlimited special formatting, boilerplating and the like. Provision is also made for background printing of a file from the editor; a good file append function to get a disk directory and then import a boilerplate document you may have saved; and even a print-extract feature, which allows you to print out marked pieces of your editor text. Nice editor.

Fine Flexibility

Though you can operate in a what-you-see-is-what-you-get mode with Select, the real power of the system comes from inserting formatting commands a la Magic

```
>INSERT: Enter text, then <ESC>        (You may use _, ^, [ OR ])
 Document: C:SELECT.REV                      Char:   61  Line:   19  Page:    1
---------L----+----+----+----+----+----+----+----+----+----+----+----+----R-----
         processors from Select Information Systems.  I like them;  the
         former is a revision (version 3.0) of the familiar Select word
         processor with significant enhancements, notably a speller and a
         mail/merge facility.  The most significant enhancement here,
         however, is a $200 price drop from $495 to $295 for the new
         version.  The latter package is a cleverly packaged subset of the
         "big" version, to be sold through bookstores and other outlets for
         $99.  Let's take a look at both of them in operation (I'm writing
         this on Select version 3.0).

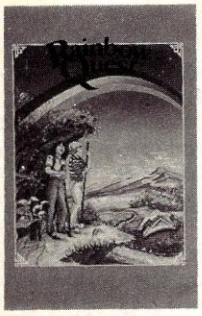
         The "big" Select is a very competent screen-oriented text editor,
         formatter, merger, and proofreader which is supplied on four
         single-sided disks, has a good reference manual, a "getting
         started" book, and very importantly for learners, a programmed
         learning program called "Teach" which is accessible not only as a
         separate tutorial but also from Select's main menu.
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Fig. 1. Select's screen.

BOOKS

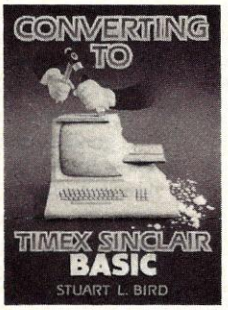
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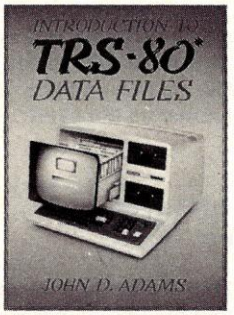
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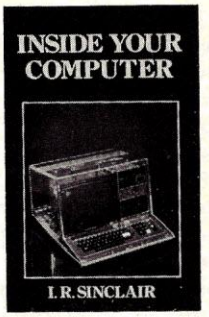
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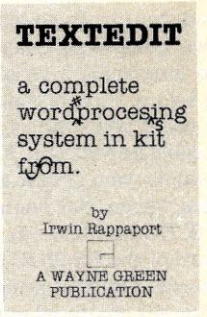
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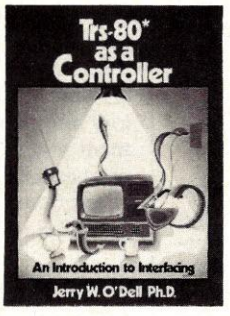
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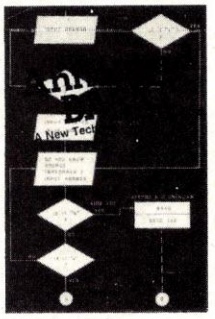
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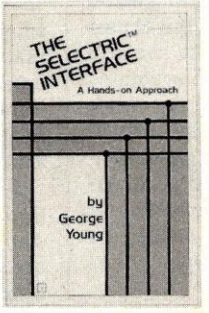
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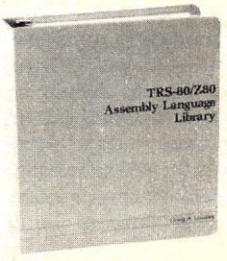
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Wand or SuperWriter. Unlike these editors, however, when you hit the format key in Select, you get a menu that allows you to make format choices for margins, paper length, justification (left, center, right or none), a forced page-break, page numbering, characters and lines per inch, whether you want to see the return markers and pointers that are inserted into the text, whether the display line should be visible, and whether on-screen justification should take place.

This screen gives you immense flexibility over the system's operation; for instance, by manipulating characters per inch and lines per inch, it's possible to get one-and-a-half line spacing (Select ordinarily supports only single, double or triple spacing) and lots in between. The format command automatically puts backslash commands in the text file; as you become expert, you can put these in yourself without using Format. There's a multiple-line header and footer facility. For instance, automatic page numbering, alternating odd/even headers and even print pausing and file comment lines can be inserted manually or automatically.

The major differences in revision 3.0 of Select lie in the inclusion of the merge and spell facilities, both of which, to my mind, operate well but need further work. Merge is a too-dedicated name and address merger that I find restrictive, though it's certainly easier to use than some of the more complicated alternatives on other systems. Merge restricts the user both to prechosen field names (Name, ADDR1, ADDR2, City, State, Zip, Phone and REF) and prelimited field lengths (30, 30, 30, 24, 2, 9, 13, and 127 characters, respectively). If you enter names in a certain special format, four other fields (Greet, Prefix, Last and First) become available for use. But that's it.

Don't try to have multiple data fields (besides REF), conditional merges or any of the more fancy features available with other systems. You either use this baby for name and address work, and just name and address work, or you "translate" what ADDR1 might mean in some awkward manner every time you use the system, trying to remember which of your three product lines this variable is substituted for. I think Merge is unnecessarily dedicated to name and address work. It shouldn't have such restrictive field lengths, should have some conditional choice abilities (i.e., if Zip = 00090, then . . .) and shouldn't have prededicated names. It works as advertised, however.

Spell is really the SuperSpell program you know and love from other applications, or at least it appears to be. It's called from the main menu. The program uses a 10,000-word dictionary (expandable by the user) to mark suspected misspellings in your text, then calls the editor and uses the Spell command there to find each mark and allow for corrections. The system works as advertised and works quickly.

But, in this age of advanced (e.g., MultiMate, WordPerfect) spelling correctors with automatic lookup and suggestions for corrections inserted automatically in the text, I think it's a kludgy way to go about spelling correction. Not that you can't make this criticism of most of the spelling correctors on the market (e.g., the one in the Peachtree 5000 system); it's only recently that in-text spell correction has been available.

I would hope to find this update in Select—at least a 100,000-word dictionary and the ability to spell-check single words, which is all that's really needed anyway.

Teach Me

One of the biggest selling points of Select will be the Teach program, which shouldn't be called a tutorial since it's a full-blown computer-assisted learning program. The PR flack on this product claims you can spend a couple of hours with Teach and be more proficient on Select than on a number of other packages. I agree; I think it's marvelously well-done. But it's not perfect; you can't get any tutorial help, for example, on Spell or Merge, two of the most complicated commands in Select. Nonetheless, if you're a newie, Teach will go a long way toward making you a sophisticate.

The major differences between Select and its baby brother, Select Write, lie in the omission of the Spell and Merge modules from Write, in the price tag and in creative packaging. The trade-off is simple: Merge and Spell for $295 or none for $99. All other features are identical as nearly as I can determine. To its credit, Select didn't make installation harder on the cheap system, or lower by much the number of printers supported, or shorten the files that can be edited.

What the company *did* do is to bind its manual in a hard-bound book that's attractive, clearly written and useful. If you're a novice and think that you won't need a merger or a speller for a while, then Select Write may be "write" for you. Of the two packages, I'd recommend Select, though, because I think you'll find the editor/formatter so useful that you'll quickly want the added features. Photo 2 gives a picture of Select Write's novel packaging.

Final Features

I'd be remiss if I didn't tell you about two more features of both programs. There's good integration in Write and Select with the IBM PC function keys; PageUp, for instance, gives a Display -1 command, which is Select's way of moving up a screen. The insert key puts you in Insert, the delete key in Delete, and so on. So adaptation to the PC from CP/M (Select's origins) hasn't been haphazard, but studied.

Also, the installation program to adapt the master disk to your machine is easy to use, configurable for both PCs and lookalikes (Eagles, Hyperions, Compaqs,) supportive of color and monochrome operation, and good about printer support (Brother, Diablo, Epsons, NEC, Okis and others). A shortcoming of the installation program in both Select and Write, however, is that neither supports port configuration, so if you're using serial configuration, you'll need to set Mode manually before operation, and if you're using LPT2:, God help you.

Obviously, I like both programs. Teach is a real value-added user benefit I wish more vendors would adopt. The systems have been well thought out in conception, operation and documentation and are now priced reasonably (at about double what they, or any other software, are worth). The existence of two different packages means you don't have to buy more or less than you need.

With some of the revisions I've suggested here, Select would be a shoe-in for the top of the crowded word processing peak. As it is, it's a solid entry. As for Write, it's tougher to predict, but I think they'll sell a pile of them.

Review of The Ultimate

This was written on The Ultimate as it was evaluated.

The Ultimate is a combination word processor, list manager, speller, mail merger and electronic mail system rolled into one, all for less than $200. I spent a while with each of the system's programs and was alternately pleased and displeased as I went along.

Overall, there's some question in my mind about the functionality of The Ultimate. Let's start with the word processor. First, the cursor keeps changing between a giant block and an underline as you type—most disconcerting. The word processor has some expected features, like justification (manually called) and reasonably good cursor movement (all character or line oriented). There's a merge feature that allows you to call in other files as well.

On the other hand, it's easy to outtype the machine, especially in the Insert mode. Provision is made for special print codes to be manually inserted in the text you're working on for emboldening or the like, but you have to type the entire page you're working on, then retrotype brackets around the special-functioned text, end-to-front only, and then resave (or save) the document. Awkward at best. Headers, footnotes, and other advanced features some users need aren't supported, though the program supports footers and multiple copy printing. I'll be back with you after I try the spelling checker . . .

The spell checker is an unintegrated

one; you call it separately from DOS. It takes a long time (over three minutes for the 57 words in the paragraph above) to check a short file and it doesn't correct or even mark errors. Rather, it saves the error list in a "spell.new" file, and it's your responsibility to print or otherwise (e.g., merge) obtain the file to make corrections to your document manually. Since the dictionary is small (13,000 words), you'll do a lot of this. You can (manually) add words to the dictionary, however. I'll be back after I fool with the database program. . . .

Fooling Around

The database manager is really a list manager, also called directly from DOS. It's a miracle of simplicity. You use the word processor to create a file (with a .DEF extension) with labels and underscores and that's it! You then call Base, the list manager, and you enter, add, delete or search for data. The limitations are that your records can't have more than 18 screen lines of information and no field can exceed 76 characters. Also, aside from finding a record (exact matches only), the list manager has no report features. It's simple, but it works. Back after I muck with the mail merge facility. . . .

The mail merger ties together list manager files, word processing templates and control files (sort/select criteria) to allow mailing labels, form letters and even database file redefinition to be done relatively easily and repetitively. You again call mail from the DOS prompt, having first created a word processing template with field numbers in brackets (it's your job to know what those numbers mean!) amidst any boiler-plate text to be typed. Then you identify the fields for inclusion by number, and they're inserted into the text.

You also can make up to 26 different sort choices to exclude some records from the database and include others. You can save your choices in a control file for repetitive report generation or use the merge program to copy an old data file to a new one, with a new field added. There's no error checking in this or any other module for duplicate filenames, so it's easy to ruin a year's work with a moment of thoughtlessness. Back after I fool with the Z-Com program.

The Post Office (USPS) has inaugurated a typically complex and stupidly unfriendly service for the transmission of electronic mail. The last module in The Ultimate automates accessing this service, providing you apply for a license to use it (form included with The Ultimate) and pay 50 bucks to Uncle. The module is function-key driven, does autodialing with a Hayes Smartmodem, and looks as if (I didn't test it—I prefer MCI Mail and no $50) it makes the process of hooking into Z-Com simple and understandable. If you have a small business and need or want Z-Com, this module may well be worth the price of the program. The service has been made as hard to use as the government can make it, and the module does a good job of simplifying things.

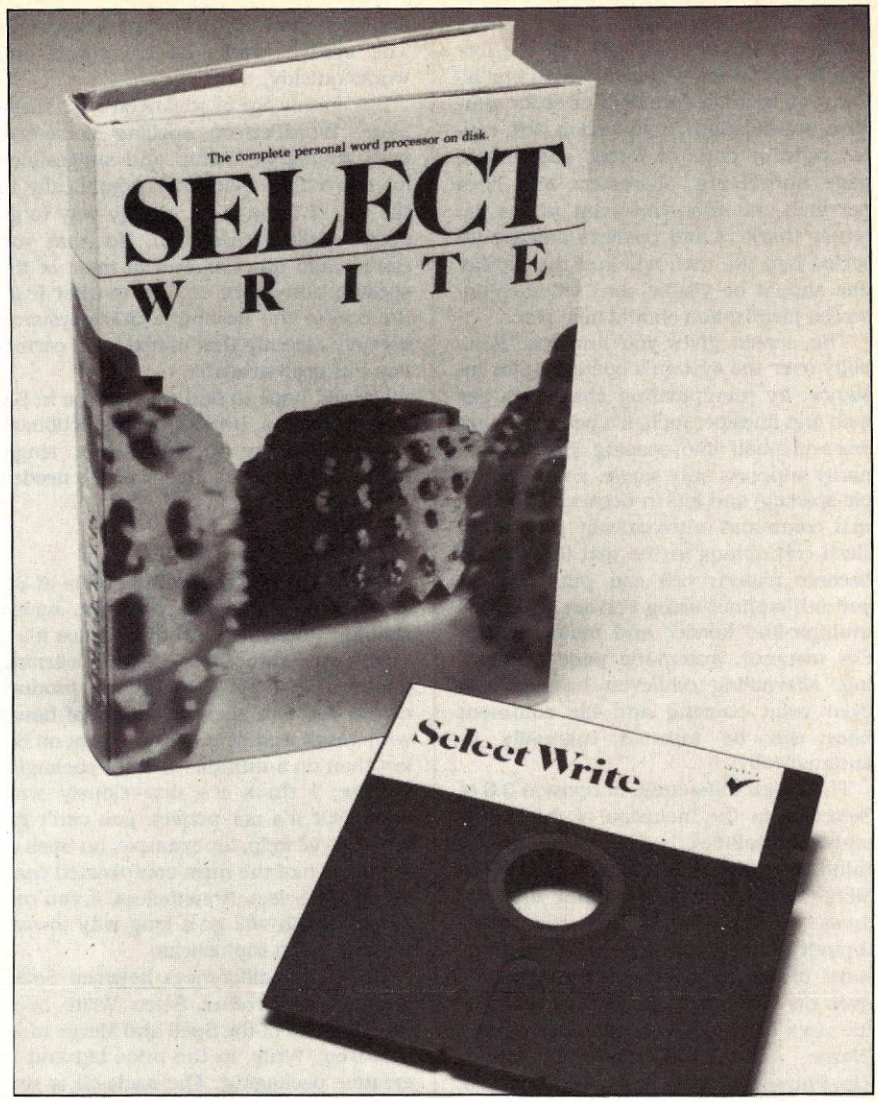


Photo 2. Select Write's packaging.

Is It for You?

So, you have an unintegrated and rather common word processor, slow and inadequate speller, simple and functional list manager, good mail merger and clean electronic mail module in The Ultimate. Is it for you? Depends, doesn't it?

If most of what you do is short, letter-type correspondence with no need for headers, footers or other fancy stuff, if you're a bad speller (so the limited dictionary and time spent using the spell package pays back), if you want a list manager that is simple and reliable, but not at all fancy, and if you need some good mail merge or electronic mail capabilities, this package may be for you. I think it would have more appeal if the designers had taken the trouble to make all the modules callable from a main menu, added some file handling checks so you don't run the risk of lunching all your work every time you use the program and taken more pains to make key use (like function keys) more integrated between the modules.

At $249, you'll want to closely assess your own needs before you buy; another $100 will get you the Peachtree system, with its -calc, speller, list manager and thesaurus functions if you can forego the electronic mail stuff. Compared to the Peachtree system, The Ultimate's word processing and list management modules don't stand up very well. On the other hand, if you need the particular mix of activities this program supports, like electronic mail, you'll find The Ultimate generally competently executed.

DataEase and Microrim

I've reviewed DataEase in this column before, but revision 2.04 has been released and it's a significant enhancement of the original program. DataEase (DE) is a complete and pretty competent

relational database management system that offers system security and a good query language to automate report generation. The system runs nicely in color on the PC and supports a wide variety of printers as well.

DE works in much the same way as some other DBMS systems as far as data entry goes. You define a form on the screen, specify the fields and then use that form to enter data. DE supports a wide variety of data types, including multiple choice and yes/no fields, time and data entries, and dollars and social security entries in addition to the more mundane text, integer and real fields. Default entry values, automatic lookup on entry and data validation are all supported, making DE's data entry facilities some of the most complete in the business. Calculated fields are supported, as are automatically sequenced fields for, say, invoice numbers that increment automatically with each form used.

Writes Reports Right

It's in query and report functions that DE really makes the manager's life easy, however. DE uses a unique English-like query language—even better, it gives you a menu of choices at each possible point in creating a report so you can't go wrong. With this system, reports seem to write themselves; DE supplies all the correct syntax, and you fill in the blanks to construct a query paragraph that generates your report.

As you get more comfortable with the query language, you can choose to type in phrases directly, but the menu-like choice structure is always there as a fallback. DE handles report generation to the screen, to print or to disk with equal ease and even has the facility to format your output, much like a good word processor. Headers, footers, characters per inch and highlighting (italics, bold and so on) can be specified at report generation time.

Being a fully relational DBMS, DE allows different data entry forms to be tied to one another by logical relationships. You can, for instance, define an employees' file with names and addresses in one form, salary histories in another and skills in a third, all tied together by employee number. The report language allows you to select such nested information easily and even to generate statistics on it.

There's lots more in DE that I can't cover here for space reasons. For instance, you can easily create menus with DE to automate database manipulations in a turnkey way for others. DE has a good facility for importing data from and exporting it to other programs, like dBase, 1-2-3 and even MailMerge. It's a nice program.

DE's manual is clear, concise and thorough; it even provides information on how data disks should be backed up and what to do to recover files. Though there is no tutorial, DE comes with a demonstration disk that gives you a pretty good idea of what it can do. My only complaint about DE is that with a large database (say, 250 records), it's slow in some of its functions, even on a hard disk. As long as report running and the like isn't done in an urgent fashion, this won't pose a problem for many users. But, I found myself very impatient waiting ten minutes or more while doing batch updates on a large file.

Microrim

Microrim R:Base Series 4000 (Microrim, or MR for short) is a DBMS that takes a different approach to handling tasks ranging from filing to fully relational applications. This program requires 256Kb of memory and DOS 1.1 or higher, but it really smokes! It may be my favorite DBMS of all time; certainly, it's one of the first database programs I've ever found that's both useful and usable—a tough combination to get in the micro canned software world.

The way to think of MR is as a friendlier, quicker and, in lots of ways, more powerful dBase II. As to friendlier, not only does MR have a good help facility, but it also has a prompt command. Just issue prompt before any command you may not be certain about using, like Tally. Say "Prompt Tally" to MR, and you'll get a fill-in-the-blanks form on the screen that makes using command options a snap.

As for quicker, you've seen MR's ads, and I can generally confirm them. Sorts, retrieval times, almost everything works quickly with MR—it's flat fast. As for more powerful, you can define up to 40 separate files (that is, relations) per database, have 400 fields (not 32, like dBase) per database, write records up to 1530 characters long and store as many records in practice as you can find disk space for.

MR doesn't have all the data types of DataEase, but I didn't miss them. All you have to claim for a data type is whether it's a date, time, dollar, number or text value; MR takes care of the rest.

With MR, you define a relation, which is a set of attributes (fields) that are used together. Each relation may use elements of previously defined relations, making MR, like DE, fully relational in nature. Once you've done this, you have the option of entering data from the keyboard a record at a time or from a disk file with MR's good Load command. From the keyboard, you can have the program ask for each field if you'd like, or you can create a form to automate entry. The forms editor is especially good and powerful.

The Fun Begins

Once data has been entered, the fun begins with MR. Its English-like report language is entered at a blank prompt, not in menu fashion like DE. But the language is so remarkably clear that you can remember it. Want to see all pieces of software you bought after 12/31/82 that have been categorized as type D(atabase) and cost less than $80? Just issue the following command:

```
SELECT ALL FROM RELATION
WHERE DATE GE 12/31/83 AND TYPE
=D AND PRICE LE $80
```

Not so hard. Want the software sorted by vendor name? Just add "SORTED BY VENDOR" to the specification. Want to see the minimum, maximum, average and sum for prices of all database software? There's a Compute command that handles this automatically. How about cross-tabulating prices by type of software? Tally does that. This is a very nice system indeed.

MR supports rules on data entry, which allow you to validate data before accepting it. The program also lets you record any sequence of keystrokes to the disk and to execute that sequence by recalling it, so that you can automate applications after doing them once.

But perhaps the most powerful commands in MR are the ones that perform database operations across relations. For instance, you can get the union of two relationships on the disk or their intersection, or even extract a subset of a larger relationship using the Project command. With Union, for example, you can add a new field (attribute) to an existing relationship. With Intersect, you can discard any rows in two relationships that don't match on a common attribute. MR is a powerful DBMS.

The report writer for the system, which is upgradable for extra money to an extended report writer, is competent but not outstanding. You work in a word processing-like environment to define header and footer text for each report as well as define the variable information to be extracted from the database. This gives you the limited ability to generate form letters, for instance. You can also define up to ten calculated variables per report, but this feature is somewhat rudimentary. You have to define separate sum and count variables, for example, and then divide the first by the second just to get a simple average of some numbers on the printout.

Perhaps the best feature of MR from my point of view is the attention the program developers gave to data transportability. There's a direct link to Multiplan SYLK files built into the program, making data transfer back and forth between these applications almost automatic. Also, I had no trouble at all transferring data from dBase to MR and from dBase to 1-2-3 via the .DIF format, and transferring data directly to a WordStar MailMerge file with the documentation given in the MR manual.

The MR manual uses a single sample database for instruction and, to my mind,

is a little thin on examples and supporting text. There is a good disk and book tutorial included with the program, however, and everything seems to be done with excellence and attention to detail. The program is well-customized to the PC and its function keys and is a good buy when you consider other systems.

Old Business

Several months ago, the InSoft people were good enough to send me a copy of their Accountant software, an integrated general ledger, AR, AP and payroll package written in Basic. Not being an accountant, or even competent enough to comment on the needs of small business users in this area, I sent the software on to a practicing CPA for a review. Mr. Swank's review is contained in the sidebar to this article. As he points out, there's lots to recommend Insoft's package, but there are some things to look out for as well.

Paperwork

Paperwork is an integrated text editor, address file and label/envelope preparer that I blasted last time for coupling unusable manuals with blank-screen confusion in the software proper. I despaired of anybody, mostly me, being able to figure it out. After reading the review, Michael Harris, president of Harris Microcomputing, called me—not to complain, but to ask what he could do to make the system more usable. I recommended redoing the documentation; he said, "Too much money." I asked for help screens—he added them, and I finally figured out how to work Paperwork.

PW keeps your addresses in a keyed file that has default salutations and sorting categories. It also has a line-oriented text editor to enter documents, business or casual letters into the computer. Once text is entered, you just tell PW which clients, or friends, get the letter, and they are automatically merged with the address file. The system also produces envelopes or labels to your specification with no more input on your part. It works well once you understand what it can do, and the help screens go a long way toward making the system understandable.

The editor works well but is clearly the weak point of the system. It isn't character-, but line-oriented and numbers lines a la Basic programs or EDLIN. It does allow control-key text and cursor manipulation (control-L for margin setting, for instance), dot commands for headers, justification and the like, and even special characters for emboldening and underlining. It is a full-functioned editor that I think suffers because of its line orientation, which means that all kinds of housekeeping commands (e.g., List) get in between the writer and the writing.

Nonetheless, if you like or can get used to line-oriented editors, PW works well and fast to generate letters of all types. The system even automatically updates your address file to show when the last letter was sent to each addressee. PW works with documents too, though here I see no advantages to the line editor and many disadvantages. Most importantly, Harris Microcomputers clearly is a firm that acts quickly when given responsible criticism, so you can hope for lots more improvement in PW. At $70, there is no cheaper mail merge utility on the market.□

Address correspondence to Thomas Bonoma, 45 Drum Hill Road, Concord, MA 01742.

This concludes Tom Bonoma's "What's New, Big Blue" column. Microcomputing isn't losing Tom's witticisms, however—Bonoma plans to tackle IBM programs as a member of our Software Review Board.

Programming Problem

Even veteran programmers can be thrown for a loop by Basic's error statements, which often use a single phrase to describe several error conditions. Here are two problems of this sort you can solve or at least struggle with. You've spent a good couple of hours keying in a 200-line program, two relevant fragments of which are given in Table 1. You check, and can't find any mistakes in what you've done. But when you run the program, you get the error message "Syntax error in 1680." How can there be a syntax error in a Data statement? What's going on here? Can you find the mistake? Better, can you tell me *why* this particular error message is generated?

Solve that one? OK, try this: same program, same everything. You go to save a fragment of the program with the statement SAVE "ERRFRAG.BAS,A", where the "A" is meant to signify you want the file saved in ASCII format so you can use it in your word processor. What's wrong with the command line? What error message will the computer return? Why? The answers are printed on page 129.

Accountant

InSoft's Accountant is an integrated general ledger, accounts receivable, accounts payable and payroll package written in Basic. Each of the menu-driven modules runs independently until month-end, when appropriate summary entries are generated and transferred into the General Ledger module. The package provides numerous internal reports needed to control a small business. With its low list price, this package may appear to be a very good deal for a small businessman contemplating automating his accounting system.

However

The documentation for the system is only fair. It contains a large number of typographical errors, and it is incomplete and poorly written in places. While most of these errors and omissions are only annoying, some can cause confusion.

You must have an understanding of basic accounting concepts to set up and run the General Ledger module. It includes a boiler-plate monthly income and balance sheet and a combined general ledger/trial balance report.

```
 340  FOR I=1 TO 4
 350  READ N(I)
 360  NEXT I
 370  FOR I=1 TO 3
 380                READ      A$(I),      B$(I),
M(I),Z(I),L1(I),L2(I),R1(I),R2(I),R3(I)
 390  NEXT I
 400  READ A$(4),M(4),Z(4)
1640  DATA 2,2,2,2
1650  DATA Electric, KWH,
          0.00,0,1,1,.0851427,.0851427,.085427
1660  DATA Gas,
          THERMS,0.00,0,50,200,.7127,.6862,.6752
1670  DATA Water, CCF,
          3,26,0,500,99999,.144,.160,0
1680  DATA Phone, 11.51, 0
1690  END
```

Table 1. Program fragments.

The Payroll system can handle salary and hourly workers, and it will keep track of monthly, quarterly and yearly earnings and deductions. However, outside of the standard social security, federal, state and local tax deductions, it retains at most three other miscellaneous deductions.

The Accounts Receivable system can handle an open item or a balance forward type of client, and these clients can be intermixed in the same master file. A potential problem with the module is that all sales transactions are transferred to a single sales account in the general ledger.

The Accounts Payable module includes most reports you will need, but one of these, the Cash Requirements report, would not run on the sample files provided with the system. The documentation advises you to contact your "computer representative for assistance" in this situation.

While the package is reasonably complete, it is fairly simple. Many small businesses may find that their needs in at least one area are not simple. For example, a restaurant may require a more extensive payroll package that can handle the recording of cash tips collected by waitresses or track year-to-date hours worked by employees. A small wholesale business may want a more extensive accounts receivable module, one that can summarize the sales of different categories of items into different sales accounts.

This package might be useful to a knowledgeable buyer with fairly simple needs. He should either talk to some users in his area or get a local dealer supporting the package to give a complete demonstration. If, however, an inexperienced user buys the package sight unseen, he could face difficulties.

Rolland Swank, CPA

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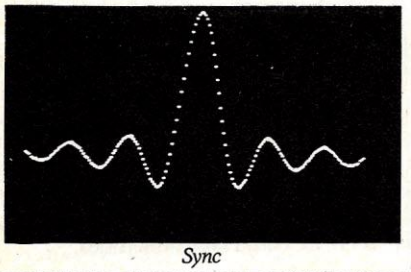
Or write: SLR SYSTEMS
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SLR Systems

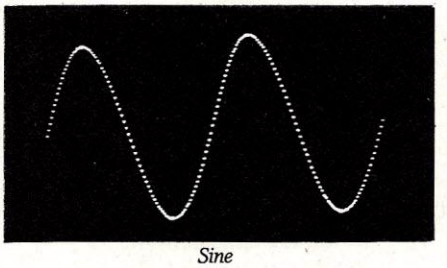
Seeing Is Believing

If you and your VIC-20 have given up on the hope of ever seeing high-resolution graphics, it's time for you to have your faith restored. This program, called Hi-Res, will let your unexpanded VIC display full-screen (176 by 184-point resolution) graphics.

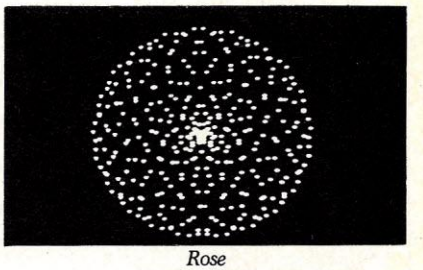
By Alan Sehmer



Sync



Sine



Rose

If you're a VIC-20 owner who has written off high-resolution graphics until you can afford more memory, this article is for you. My Hi-Res program lets an unexpanded VIC display full-screen graphics with 176 by 184-point resolution.

Hi-Res (Listing 1) is a small, easy-to-use Basic program. Hi-Res graphics use rectangular coordinates with x in the range of 0–175 and y in the range of 0–183. The point 0.0 is in the lower left corner. Lines 10–1930 are for your graphics programs.

To use Hi-Res in your own programs, simply have your program calculate x,y values and then Gosub 2000. If you give Hi-Res an out-of-range number, no harm is done; it's ignored. Three graphics programs written to work with Hi-Res are shown in Listings 2 through 5.

Type the Hi-Res listing along with one of the example graphics programs, type RUN and press return. The screen should go blank and, after about five seconds, go black. After about ten more seconds, your graph should appear.

Once the graph is done, the VIC goes into an endless loop (line 1940). The graph stays on the screen until you press run/stop and restore. Pressing only run/stop stops the program, but the VIC will only display garbage instead of numbers and letters.

One last note on program use. Not all xs and ys are created equal. If you run Listing 4, you'll find that the rose graph is an ellipse instead of a circle. Try changing line 30 to:

```
30 X=(COS(Z)*R)*.7+85
```

You should now get a nice circular graph. One step in y is about 70 percent of one step in x.

But Wait...

If you're thinking Hi-Res is too good to be true, you're right. There's a catch. There's a limit to the number of points that may be used. This limit changes from graph to graph and depends on how close together the points are.

The smallest limit is about 200, but in most graphs the limit is much bigger. I don't know of any way to determine this limit ahead of time. I've found it best to not worry about any limit until Hi-Res gives me an overflow message. When this happens, I just make the graph a little smaller.

How It Works

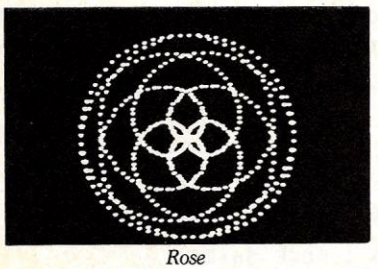
High-resolution graphics on the VIC is nothing new. The *Programmer's Reference Guide* contains a section on high-resolution graphics and my program is based on that section. The program in the book has some serious limitations—it uses only a small portion of the screen and both x and y values are limited to the range of 0–63. Hi-Res overcomes both shortcomings.

The keys to any high-resolution graphics program are user-definable characters. In the VIC's ROM, a lookup table tells the VIC how to form all the letters, numbers and special characters.

Each character uses eight bytes of memory. Table 1 shows the first 16 bytes of the lookup table in decimal, hexadecimal and binary. Notice the pattern of 1s in the binary numbers. The first eight bytes define the character @; the second eight, the letter A. Studying this arrangement, you can see how any letter, number or graphics character could be made. For example, the Greek letter delta can be formed as in Table 2.

One small problem: the lookup table is in ROM, and no number in the table can be changed. Fortunately, the folks at Commodore use a programming tool called a pointer. A pointer is a location in memory that holds an address. This address points to a table, a machine-language routine, a memory boundary or almost anything else.

In the VIC, one of these pointers



Rose

points to the character lookup table. Every time the CPU needs to know how to form a character, it checks this pointer to find the table. Because this pointer is in RAM, it can be changed to point anywhere in memory.

In the Hi-Res program the pointer points to high RAM (location 6144). After the pointer is changed, the CPU thinks location 6144 is the start of the lookup table. With the lookup table in RAM any number can be poked in so any character can be built.

Listing 5 is a program that defines one new character, the delta. Line 10 changes the pointer to point at the new character lookup table in RAM. The pointer is at memory location 36869. The for . . . next loop reads the numbers for the character and pokes them into the first eight memory locations of the table.

Type in the program and run it. The first thing you notice is that all the characters on the screen turn into gibberish. That's because only the first character in the lookup table is defined; when the CPU looks up any character other than the first, it receives random bit patterns and displays them. Press the @ key; the delta should be displayed. The @ is the first character in the table, which is the one character defined.

One other section of memory, called screen memory, is used. This memory area (located from 7680–8185 decimal) has one byte of memory for each print position on the screen. The screen memory is in RAM and is arranged with location 7680 as the upper left corner of the screen and location 8185 as the lower right.

If location 7680 contains a zero, the VIC prints the first character of the character lookup table in the upper left corner. (Remember—computer people start counting with zero.) If location 7680 contains a one, the second character in the table is displayed in the upper left corner. Using the Poke statement, you can force the VIC to print any character in any position you want.

You now have all the tools you need to draw graphs. You can define your own characters and put them anywhere on the screen.

The Memory Fails . . .

The limiting factor to full-screen, high-resolution graphics on an unexpanded VIC is—you guessed it—memory. It would be great if every print location on the screen had its own eight bytes of memory in the character table, but that works out to 4048 bytes.

If you define your character table to be locations 6144 to 7679 (any higher and you run into screen memory, any lower and you won't have much room for Basic programs), you have 1537 bytes, or 192 characters, that you can define. There are 506 print locations on the screen and you can define 192 characters; the trick is spreading those 192 characters to cover 506 print locations.

If you take a close look at most simple graphs, you find that most of the paper is blank. Knowing this, you can save a lot of memory if you define a blank character and use it over and over for most of the graph. This is how Hi-Res works; it defines the first character (character zero) in the character lookup table as a blank and fills the screen with it. As Hi-Res receives x,y values from your graphics program, it defines new characters and pokes them into the proper places in screen memory. With this method you use your 192 characters sparingly, only putting them where you have a line.

Each print position on the screen is eight points wide and eight points high. Most graphs need to put points closer together than once every eight places. Hi-Res first finds where on the screen the next point is to go. It then checks to see if a character has been defined for that location. If one has, Hi-Res redefines that character to include the new point and pokes it back to the screen, again stretching the 192 characters as far as they'll go.

You can now see why the limit to the number of points changes from graph to graph. If you have a graph that has four points, one in each corner, you'll have to define four characters. If, however, the four points are right next to each other, chances are you'll have to define only one character. Once you use all 192 characters, it's all over and Hi-Res gives the overflow error.

Inside Hi-Res

Now that you have a general idea of how VIC graphics works, let's see how Hi-Res brings it all together.

Lines 1940–1990 make up the initialization routine. Printing CHR$(147) is just a fancy way to clear the screen. The pokes to 52 and 56 are to set some more pointers. When you put the new character table in memory, you need to keep the Basic interpreter from using that memory. The pointer at 56

Decimal	Hex	Binary
28	1C	00011100
34	22	00100010
74	4A	01001010
86	56	01010110
76	4C	01001100
32	20	00100000
30	1E	00011110
0	0	0000000
24	18	00011000
36	24	00100100
66	42	01000010
126	7E	01111110
66	42	01000010
66	42	01000010
66	42	01000010
0	0	00000000

Table 1. A section of the VIC's character table.

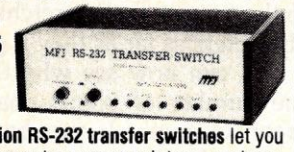
Decimal	Hex	Binary
0	0	00000000
24	18	00011000
24	18	00011000
36	24	00100100
36	24	00100100
66	42	01000010
126	7E	01111110
0	0	00000000

Table 2. A new character, delta.

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MFJ-1243	$119.95	1	4	MFJ-1247 switches 20 lines	$99.95	1	2

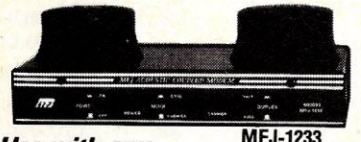
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points to the top of free RAM; this pointer is originally set during the VIC power-up routine. (Actually, the pointer uses two addresses, 55 and 56, but address 55 already contains the correct value, so you need only change 56.) With this pointer changed, the VIC thinks that memory ends at 6143, just below your table.

The pointer at 51 and 52 points to the start of string memory. Before any programs are run, this pointer is set to the top of RAM. Since the top of RAM has been moved, the string pointer must also be moved.

Line 1960 clears the memory that will be used for the character table. The poke to 36869 changes the pointer to the character lookup table; the poke to 36879 tells the VIC that you want a black screen, black border and white characters. Line 1980 clears the screen memory. Line 1990 sets the character counter, variable CC. CC keeps track of how many characters have been defined.

Lines 2000–2110 are the main program. Lines 2000–2030 round the incoming xs and ys and check for out-of-range values. If any numbers are out of range, the rest of the program is skipped.

Line 2040 finds the screen memory column address, the number that tells Hi-Res into which screen column the point should go. The 8164 offset is needed to put the variable MC into screen memory, with address 8164 being the print position in the lower left of the screen.

Line 2050 calculates which point (PW) in a column to light. Each point has a corresponding bit in the character table and each bit is a power of two from zero to seven (see Table 1). Line 2050 computes PW to the proper

```
5 GOSUB 1950
10 ;   PUT YOUR GRAPH PROGRAM IN LINES 10-1930
20 ;   GRAPH PROGRAM SHOULD GIVE SUBROUTINE 2000
30 ;    X VALUES BETWEEN 0,175  Y VALUES BETWEEN 0,183
1940 GOTO 1940
1950 PRINT CHR$(147) : POKE 52,24 : POKE 56,24
1960 FOR P=6144 TO 7679 : POKE P,0 : NEXT
1970 POKE 36869,254 : POKE 36879,8
1980 FOR P=7680 TO 8185 : POKE P,0 : NEXT
1990 CC=1 : RETURN
2000 XP=INT(X+.5)
2010 YP=INT(Y+.5)
2020 IF XP<0 OR XP>175 THEN 2110
2030 IF YP<0 OR YP>183 THEN 2110
2040 MC=8164+INT(XP/8)
2050 PW=7-(XP/8-INT(XP/8))*8
2060 CP=INT(YP/8) : IF PEEK(MC-22*CP)<>0 THEN 2080
2070 POKE MC-22*CP,CC : CC=CC+1 : IF CC=193 THEN 2120
2080 TC=PEEK(MC-22*CP) : MA=CP*8-YP
2090 BY=6144+TC*8+7+MA
2100 POKE BY,PEEK(BY) OR (2^PW)
2110 RETURN
2120 POKE 36869,240 : POKE 36879,27
2130 PRINT CHR$(147)
2140 PRINT "OVER FLOW --- GRAPH HAS TOO MANY POINTS" : END
```

Listing 1. The Hi-Res program.

```
10 X=0
20 FOR Z=0 TO 4*π STEP 4*π/175
30 Y=90*(SIN(Z)+1)
40 GOSUB 2000
50 X=X+1
60 NEXT
```

Listing 2. Sample graphics program.

```
10 FOR Z=0 TO 2*π STEP 2*π/500
20 R=SIN(36*Z)*65
30 X=COS(Z)*R+85
40 Y=SIN(Z)*R+90
50 GOSUB 2000
60 NEXT
```

Listing 3. Sample graphics program.

```
10 X=0
20 FOR Z=-6*π TO 6*π STEP 12*π/175
30 Y=100*(SIN(Z)/Z)+50
40 GOSUB 2000
50 X=X+1
60 NEXT
```

Listing 4. Sample graphics program.

```
10 POKE 36869,254
20 FOR X=6144 TO 6151
30 READ A
40 POKE X,A
50 NEXT
60 DATA 0,24,24,36,36,66,126,0
```

Listing 5. Sample graphics program.

power of two to correctly position the point in the print column.

Line 2060 determines the screen row where the point goes. It then finds the address, in screen memory, of that print position and determines if that position has already been defined in the character table. If the screen memory for the print position contains a zero, the CPU looks up the first character in the character table, which has been left as a blank. If the character for the print position is a blank, it's safe to say that this point hasn't been plotted.

Line 2070 defines screen memory addresses. Hi-Res knows the screen memory address (MC–22*CP), as well as the next character in line in the character table (CC), so it pokes CC into screen memory. It then updates CC and determines the number of characters defined.

All that remains is to set the correct bit in the character table. This is done by the next three lines. The variable TC represents the character in the character table that's going to be changed. If the current print position was just defined in line 2070, TC equals CC, but if this position was defined earlier (this happens when two plot lines cross), TC is smaller than CC. The variable MA represents one of the eight bytes of the character, the one to be changed. BY puts TC, MA and the offset of 6144 together, giving the memory address of the byte to alter. Finally, the bit is poked into memory. Notice that a simple Poke won't do; the program must perform a logical Or with the new bit and any other bits that may be there so that no old points are destroyed.

The rest of the program contains the error message. The program pokes to return to the normal character set and screen colors, and to clear the screen and print the message.

An Experiment

If all this is still a little fuzzy, try loading Hi-Res and Listing 3, then add:

```
70 POKE 36869,240
```

This restores the normal character set after Hi-Res plots the sine function. Refer to pages 141 and 142 of the VIC manual. The chart there shows the character that goes with each character code (use set 1).

Note that after the program runs, the screen fills mostly with the @ character. @ is the first character in the normal table. In your "custom" table, though, the first character is a blank. Study the path of the sine function and you'll be able to see how Hi-Res went down through the character codes.

Next, press run/stop and restore, delete line 70 and run the program again. When the plotting stops, press run/stop, *but not* restore. Then press shift and clr/home. The VIC is now in its Ready mode, the same as if you had stopped and cleared the screen for any other program.

The difference, however, is that you are still using your own character table. The points all over the screen are VIC's attempt to clear the screen. It tried to fill the screen with blanks, but instead it used one of your graphics characters. Now press the A key, and you'll see the graphics character that Hi-Res defined to replace the A.

Look at more of your defined characters; the first 68 are defined. It's hard to believe that these characters, when put together, draw the sine function.

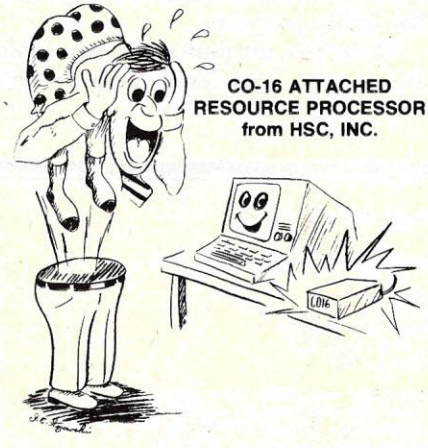
One last comment. In Listing 4, line 20, change the value 36 to a different value. Also change the value 500 in line 10. You'll be amazed with what you can get.■

Alan Sehmer (150A Lorretta Drive, Corrales, NM 87048) is a high-speed motion picture photographer for Sandia Labs.

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The Attributes They Are A' Changin'

By Ian Ashdown

CP/M-80 recognizes only two file attributes (read-only and system). Although they can be useful, there is no convenient way to set or reset them. Enter SETATT, a utility that changes CP/M file attributes. With a little ingenuity, this assembly language program will let you customize your programs with far fewer difficulties.

For those of you unfamiliar with file attributes, a word of explanation: most computer operating systems allow you to assign various status indicators to a file. These indicators, or attributes, determine the operations that can be performed on the file by an application program.

CP/M-80 (versions 1.4 through 2.2) recognizes only two such attributes, read-only and system. Through these attributes, any CP/M-80 file can be assigned either a read/write (R/W) or read-only (R/O) status, and a directory (DIR) or system (SYS) status.

A file that is designated as R/W can be read from, written to or erased by any application program, and one that is designated as a directory file will be displayed by the DIR command in a directory listing. A file that is assigned the R/O attribute can only be read; it cannot be written to or erased by most application programs. Similarly, a file designated as a system file won't be displayed in a directory listing resulting from a DIR command or most similar utility programs.

These files attributes can be useful. It's a rare individual who doesn't mind inadvertently erasing something by typing ERA *.COM instead of ERA B:*.COM. By assigning an R/O status to important files, this situation is avoided. It's also nice to be able to examine a directory listing without having to scan all the names of utility programs kept on your disks. By making these programs system files, the directory listing can be limited to those files that are of interest.

Unfortunately, CP/M-80 doesn't offer any convenient way to set or reset these file attributes, especially when more than one file is handled at a time. They must be changed with a utility program. The only one normally available at the CP/M command level is Stat, which uses, for example, the command line STAT NO-NAME .*$R/O to set the system attribute of all files with the filename NO-NAME to read-only. STAT might respond with something like:

NO-NAME.ASM set to $R/O
NO-NAME.HEX set to $R/O
NO-NAME.COM set to $R/O
NO-NAME.TXT set to $R/O
NO-NAME.INT set to $R/O

Stat Problems

Suppose, however, that you don't want NO-NAME.TXT set to R/O. You'll then have to rerun Stat using the command line STAT NO-NAME .TXT.$R/W to reset the system attribute for this one file. Also, you may be surprised by the appearance of NO-NAME.INT, which is a system file you didn't realize was on the disk. Was it an R/W or R/O before you issued the command? With Stat you'll never know—it sets or resets the attribute of any file whose filename matches that given in the command

Listing 1. A file attribute change utility for CP/M.

```
;
;           SETATT - A FILE ATTRIBUTE CHANGE UTILITY FOR CP/M
;
;           Copyright:  Ian Ashdown
;                       byHeart Software
;                       2 - 2016 West 1st Avenue
;                       Vancouver, B.C. V6J 1G8
;                       December 15th, 1983
;
;           NOTICE: This program has been released into the
;                   public domain for non-commercial use. As
;                   this assembly-language listing forms the
;                   only documentation for the use of SETATT,
;                   it is requested that any copies of
;                   SETATT.COM made for redistribution include
;                   this listing.
;
;           Version:    1.0
;
;           Use: "SETATT" is designed to replace CP/M's "STAT"
;                utility for setting the READ-ONLY and SYSTEM
;                attributes of a file.
;
;                The command line syntax expected by SETATT is:
;
;                  SETATT filename.typ (specifier)
;
;                where (specifier) can be one of:
;
;                  R/W     to reset files to Read/Write
;                  R/O     to set files to Read-Only
;                  DIR     to reset files to Directory
;                  SYS     to set files to System
;
;                The following example indicates how to use
;                SETATT to set a group of files to R/O. The
;                symbol (x) denotes that the operator has typed
;                the character 'x' at the console as a
;                response. Note that the wild card characters
;                "?" and "*" are permitted to specify ambiguous
;                file names. Also (not shown), typing ^C in
;                response to any question will terminate the
;                program without changing any file attributes.
;
;           Example:
;
;   A>SETATT PRO*.??? R/O
;
;   SETATT - Version 1.0                    Copyright 1983
```

More

Address correspondence to Ian Ashdown, byHeart Software, 2-2016 West First Ave., Vancouver, BC V6J 1G8, Canada.

line—whether or not that attribute was correct to begin with!

There are other problems with using Stat to change file attributes. Occasionally, you might enter something like STAT A:*.COM $SYS when you meant to enter STAT B:*.COM $SYS. Stat immediately assigns a SYS attribute to all your command files on drive A. Now that your DIR command doesn't list them, how can you remember which ones to reassign a DIR attribute to? The only solution is to use STAT *.COM $DIR and then individually reassign the SYS attribute to those files that originally had it—assuming you can remember, that is.

The result of such Stat antics is that many CP/M users ignore the file attributes and keep all files as R/W and DIR, preferring to suffer an occasional mishap than put up with shuffling file attributes back and forth with Stat.

Utility Program Plus

What you need is a utility program designed specifically to set or reset the attributes of one or more files. It should be easy to understand and use, and it should:

1. Accept an unambiguous or an ambiguous filename.
2. Find all files that don't have the desired file attribute.
3. Display each filename and the status of the attribute that won't be changed.
4. Ask the operator whether the attribute in question should be changed before proceeding to the next filename.
5. Having displayed all relevant files, it should ask the operator for final confirmation before actually changing the attributes of the indicated files.

The accompanying listing is for just such a program called SETATT. It is written in 8080-assembly language for Digital Research's ASM assembler (distributed free with every copy of CP/M-80) and will function properly under both CP/M-80 version 1.4 and versions 2.0 through 2.2. The code has been written in a modular fashion with extensive and detailed comments added, so that even a newcomer to assembly language programming should have few difficulties in customizing the program. A full explanation of the program's use is included in the listing (see Listing 1).

Once you have used SETATT for a few days, you'll probably agree that file attributes are indeed a very good idea—all it takes is a little ingenuity to make them useful!■

Listing 1 continued.

```
                ;   File Name:          SYSTEM Attribute:  Change to READ-ONLY?
                ;
                ;   A: PROG    .TXT     DIRECTORY          ?  (Y) Yes
                ;   A: PROG    .ASM     DIRECTORY          ?  (N) No
                ;   A: PROG    .001     SYSTEM             ?  (N) No
                ;   A: PROGRESS.BAS     DIRECTORY          ?  (Y) Yes
                ;   A: PROGRESS.INT     DIRECTORY          ?  (Y) Yes
                ;
                ;   O.K. to change?   (Y) Yes
                ;

                ;       *** DEFINITIONS ***

0000 =          BOOT    EQU     0000H   ;Warm start vector
0005 =          BDOS    EQU     0005H   ;FDOS entry vector
005C =          FCB1    EQU     005CH   ;Default file control block #1 address
006C =          FCB2    EQU     006CH   ;Default file control block #2 address
0080 =          DFDMA   EQU     0080H   ;Default DMA address

0002 =          CONOUT  EQU     02H     ;BDOS console output function
0006 =          DIRCIO  EQU     06H     ;BDOS direct console I/O function
0009 =          PSTRNG  EQU     09H     ;BDOS print string function
0011 =          SRCHF   EQU     11H     ;BDOS search for first function
0012 =          SRCHN   EQU     12H     ;BDOS search for next function
0019 =          DSKNO   EQU     19H     ;BDOS return current disk function
001E =          SETFAT  EQU     1EH     ;BDOS set file attributes function

0007 =          BELL    EQU     07H     ;ASCII bell
000A =          LF      EQU     0AH     ;ASCII line feed
000D =          CR      EQU     0DH     ;ASCII carriage return

0000 =          RWATT   EQU     0       ;Read/write flag
0001 =          ROATT   EQU     1       ;Read-only flag
0002 =          DIRATT  EQU     2       ;Directory flag
0003 =          SYSATT  EQU     3       ;System flag

                ;       *** MAIN PROGRAM ***

0100            ORG     0100H   ;Start of main program
0100 31C007     LXI     SP,STACK;Set stack pointer to local stack
0103 115F05     LXI     D,HEAD1 ;Print first part of program heading
0106 CDD003     CALL    PRINT
0109 CDA701     CALL    INIT    ;Initialize variables
010C 21C007     LXI     H,FNBA  ;Store address of start of File Name
010F 22B007     SHLD    BUFF    ;Buffer Array in pointer BUFF
0112 CDB301     CALL    GETATT  ;Get attribute type from default FCB #2
0115 CA2101     JZ      ATTOK   ;Jump to ATTOK if attribute type is
                                ;valid
0118 11E803     LXI     D,ATTERR;Print "ATTRIBUTE ERROR" message if
011B CDD003     CALL    PRINT   ;invalid or missing attribute type
011E C30000     JMP     BOOT    ;Return to CP/M
0121 CDE901     ATTOK   CALL    SFIRST  ;Search for first file match
0124 CDFB01     CALL    QFFND   ;Check to see if a file match was found
0127 C23301     JNZ     FFND    ;Jump to FFND if match found, otherwise
012A 118606     LXI     D,NFMSG ;print "NO FILE" message
012D CDD003     CALL    PRINT
0130 C30000     JMP     BOOT    ;Return to CP/M

0133 CD0302     FFND    CALL    MOVNAME ;Move file name to current File Name
                                ;Buffer
0136 CD2402     CALL    INCBUFF ;Increment File Name Buffer Array pointer
0139 CDF201     CALL    SNEXT   ;Search for next file match
013C CDFB01     CALL    QFFND   ;Check to see if a file match was found
013F C23301     JNZ     FFND    ;Loop to FFND if match found

0142 21C007     LXI     H,FNBA  ;Reset File Name Buffer Array pointer
0145 22B007     SHLD    BUFF
0148 CD2F02     CALL    SAVECNT ;Save copy of Directory File Count
014B CD3602     CALL    QDSK    ;Determine name of specified disk
014E CD4C02     CALL    PRTHD   ;Print remainder of program heading

0151 CD7302     NEXTFN  CALL    TFATT   ;Test existing file attributes
0154 3AAF07     LDA     ATTR    ;Get Attribute Type register contents
0157 FE00       CPI     RWATT   ;Is it R/W?
0159 CA6A01     JZ      RWDIR   ;Yes - jump to RWDIR
015C FE02       CPI     DIRATT  ;Is it DIR?
015E CA6A01     JZ      RWDIR   ;Yes - jump to RWDIR
0161 CD8A02     CALL    TFATC   ;Test for file attribute of interest
0164 C27E01     JNZ     NEXTFN2 ;Jump to NEXTFN2 if file attribute
0167 C37001     JMP     NEXTFN1 ;and attribute type are READ-ONLY
                                ;or SYSTEM

016A CD8A02     RWDIR   CALL    TFATC   ;Test for file attribute of interest
016D CA7E01     JZ      NEXTFN2 ;Jump to NEXTFN2 if file attribute
                                ;and attribute type are READ/WRITE
                                ;or DIRECTORY

0170 3EFF       NEXTFN1 MVI     A,0FFH  ;Set File Found Flag
0172 32B707             STA     FFFLAG
0175 CD9E02             CALL    PRTFN   ;Print current file name
0178 CDEA02             CALL    PFATT   ;Print existing (unchanged) file
                                ;attribute
017B CD0503             CALL    QCHG    ;Ask if attribute is to changed

017E CD2402     NEXTFN2 CALL    INCBUFF ;Increment File Name Buffer Array pointer
0181 21B207             LXI     H,DFCNT ;Decrement Directory File Count
0184 35                 DCR     M       ;register
0185 C25101             JNZ     NEXTFN  ;Loop to NEXTFN if more files

0188 3AB707             LDA     FFFLAG  ;Return to CP/M if specified files
018B FEFF               CPI     0FFH    ;already have desired attributes
018D C25A03             JNZ     ALLOK
0190 3AB607             LDA     QFLAG   ;Return to CP/M if no file attributes
0193 FEFF               CPI     0FFH    ;are to be changed
0195 C20000             JNZ     BOOT
0198 21C007             LXI     H,FNBA  ;Store address of start of File Name
019B 22B007             SHLD    BUFF    ;Buffer Array in pointer BUFF
019E CD6F03             CALL    QOK     ;Ask if attributes of indicated files
                                ;should be changed
01A1 DCA303             CC      DOCHG   ;Change attributes of indicated files
                                ;if O.K.
```

More

Listing 1 continued.

```
01A4 C30000             JMP     BOOT    ;Return to CP/M

                ;       *** SUBROUTINES ***

                ;       INITIALIZE VARIABLES

01A7 3E00       INIT    MVI     A,0
01A9 32B207             STA     DFCNT   ;Clear Directory File Count register
01AC 32B707             STA     FFFLAG  ;Clear File Found Flag
01AF 32B607             STA     QFLAG   ;Clear Query flag
01B2 C9                 RET

                ;       GET ATTRIBUTE TYPE FROM DEFAULT FCB #2

01B3 217D07     GETATT  LXI     H,RW    ;Set HL to point to 'R/W' string
01B6 3E00               MVI     A,RWATT ;Store R/W attribute flag in accumulator
01B8 CDD701             CALL    CMPATT  ;Compare attribute type to 'R/W' string
01BB C8                 RZ              ;Return if successful match
01BC 218107             LXI     H,RO    ;Set HL to point to 'R/O' string and
01BF 3E01               MVI     A,ROATT ;process as above
01C1 CDD701             CALL    CMPATT
01C4 C8                 RZ
01C5 211505             LXI     H,DIR   ;Set HL to point to 'DIR' string and
01C8 3E02               MVI     A,DIRATT;process as above
01CA CDD701             CALL    CMPATT
01CD C8                 RZ
01CE 218507             LXI     H,SYS   ;Set HL to point to 'SYS' string and
01D1 3E03               MVI     A,SYSATT;process as above
01D3 CDD701             CALL    CMPATT
01D6 C9                 RET

                ;       COMPARE ATTRIBUTE TYPE TO STRING

01D7 32AF07     CMPATT  STA     ATTR    ;Store attribute type in ATTR
01DA 0603               MVI     B,3     ;Set character counter to 3
01DC 116D00             LXI     D,FCB2+1;Set DE to point to first character
                                        ;of default FCB #2
01DF 1A         NEXTCH  LDAX    D       ;Get next character
01E0 BE                 CMP     M       ;Compare it to string character
01E1 C0                 RNZ             ;Return if no match
01E2 13                 INX     D       ;Increment default FCB #2 pointer
01E3 23                 INX     H       ;Increment string pointer
01E4 05                 DCR     B       ;All done?
01E5 C2DF01             JNZ     NEXTCH  ;Jump to NEXTCH if not
01E8 C9                 RET             ;Zero flag indicates successful match

                ;       SEARCH FOR FIRST FILE

01E9 115C00     SFIRST  LXI     D,FCB1  ;Search for first file match
01EC 0E11               MVI     C,SRCHF
01EE CD0500             CALL    BDOS
01F1 C9                 RET

                ;       SEARCH FOR NEXT FILE

01F2 115C00     SNEXT   LXI     D,FCB1  ;Search for next file match
01F5 0E12               MVI     C,SRCHN
01F7 CD0500             CALL    BDOS
01FA C9                 RET

                ;       DETERMINE IF FILE FOUND

01FB FEFF       QFFND   CPI     0FFH    ;Did search operation return -1 in ACC?
01FD C8                 RZ              ;If ACC = -1 (file not found)
                                        ;then return
01FE 21B207             LXI     H,DFCNT ;Increment Directory File Counter
0201 34                 INR     M       ;(file found)
0202 C9                 RET

                ;       MOVE FILE NAME FROM DEFAULT DMA ADDRESS TO CURRENT
                ;       FILE NAME BUFFER

0203 2AB007     MOVNAME LHLD    BUFF    ;Set File Name Buffer Array pointer in DE
0206 EB                 XCHG
0207 218000             LXI     H,DFDMA ;Set default DMA address file name
020A 87                 ADD     A       ;pointer in HL. (Search functions
020B 87                 ADD     A       ;return four FCB's in 128-byte default
020C 87                 ADD     A       ;buffer, with returned value in A
020D 87                 ADD     A       ;indicating which is the correct FCB.
020E 87                 ADD     A       ;Multiplying A by 32 and adding the
020F 85                 ADD     L       ;result to HL makes HL point to the
0210 6F                 MOV     L,A     ;correct FCB.)
0211 3A5C00             LDA     FCB1    ;Get specified disk number from default
                                        ;FCB #1
0214 77                 MOV     M,A     ;Store it in current File Name Buffer
0215 060F               MVI     B,15    ;Set file name character counter
0217 7E         NEXTCH1 MOV     A,M     ;Move file name characters
0218 12                 STAX    D
0219 23                 INX     H
021A 13                 INX     D
021B 05                 DCR     B
021C C21702             JNZ     NEXTCH1

                        ;NOTE - byte following file name in current File Name
                        ;Buffer is used as Change Attribute flag. Zero means
                        ;no change, -1 means change attribute.

021F 23                 INX     H       ;Increment HL to point to Change
0220 3E00               MVI     A,0     ;Attribute byte and set it to zero to
0222 77                 MOV     M,A     ;indicate that attribute is not to be
                                        ;changed
0223 C9                 RET

                ;       INCREMENT FILE NAME BUFFER ARRAY POINTER

0224 2AB007     INCBUFF LHLD    BUFF    ;Get current value of File Name Buffer
                                        ;Array pointer
0227 111000             LXI     D,16    ;Increment by 16 bytes
022A 19                 DAD     D
022B 22B007             SHLD    BUFF    ;Store new value
022E C9                 RET

                ;       SAVE COPY OF DIRECTORY FILE COUNT

022F 3AB207     SAVECNT LDA     DFCNT   ;Get number of directory files
0232 32B307             STA     DFCNT1  ;Store in Aux. Directory File Count
0235 C9                 RET             ;register

                ;       DETERMINE NAME OF SPECIFIED DISK

0236 3A5C00     QDSK    LDA     FCB1    ;Get disk number from default FCB #1
0239 FE00               CPI     0       ;If none specified then get current
023B CC4402             CZ      CURRENT ;disk number
023E C640               ADI     40H     ;Convert number to ASCII disk name
0240 32B407             STA     DSK     ;Store it in DSK
0243 C9                 RET

0244 0E19       CURRENT MVI     C,DSKNO ;Get current disk number
0246 CD0500             CALL    BDOS
0249 C601               ADI     1
024B C9                 RET

                ;       PRINT REMAINDER OF PROGRAM HEADING

024C 11B305     PRTHD   LXI     D,HEAD2 ;Print HEAD2
024F CDD003             CALL    PRINT
0252 3AAF07             LDA     ATTR    ;Get Attribute Type register contents
0255 FE02               CPI     DIRATT  ;Is it DIR or SYS?
0257 F26002             JP      PRTHD1  ;Yes - jump to PRTHD1
025A 11C305             LXI     D,HEAD3A;Print HEAD3A
025D C36302             JMP     PRTHD2
0260 11E205     PRTHD1  LXI     D,HEAD3B;Print HEAD3B
0263 CDD003     PRTHD2  CALL    PRINT
0266 3AAF07             LDA     ATTR    ;Get Attribute Type register contents
0269 4F                 MOV     C,A     ;Store it as a 16-bit value in BC
026A 0600               MVI     B,0
026C 219F07             LXI     H,HDMSG ;Set HL to point to base of HDMSG
026F CDC703             CALL    TBLPRT  ;Print the indicated message
0272 C9                 RET

                ;       TEST EXISTING FILE ATTRIBUTES

0273 2AB007     TFATT   LHLD    BUFF    ;Set HL to point to current File Name
```

More

Listing 1 continued.

```
                                        ;Buffer
0276 110900             LXI     D,9     ;Add 9-byte offset to point to READ
0279 19                 DAD     D       ;attribute byte
027A 7E                 MOV     A,M     ;Get READ file attribute byte
027B E680               ANI     80H     ;Mask off READ attribute bit
027D 07                 RLC             ;Save result as bit 1 of file attribute
                                        ;byte
027E 47                 MOV     B,A     ;Store it temporarily in register B
027F 23                 INX     H       ;Increment pointer to SYSTEM attribute
                                        ;byte
0280 7E                 MOV     A,M     ;Get SYSTEM attribute byte
0281 E680               ANI     80H     ;Mask off SYSTEM attribute bit
0283 07                 RLC             ;Save result as bit 2 of file attribute
0284 07                 RLC             ;byte
0285 80                 ADD     B       ;Add bit 1 from register B
0286 32B507             STA     FATT    ;Store result in File Attribute
0289 C9                 RET             ;register

                ;       TEST FOR FILE ATTRIBUTE TO BE CHANGED

028A 3AAF07     TFATC   LDA     ATTR    ;Get Attribute Type register contents
028D FE02               CPI     DIRATT  ;Is it DIR or SYS?
028F F29802             JP      TFATC1  ;Yes - jump to TFATC1
0292 3AB507             LDA     FATT    ;Get File Attribute register contents
0295 E601               ANI     01      ;Test READ attribute bit
0297 C9                 RET

0298 3AB507     TFATC1  LDA     FATT    ;Get File Attribute register contents
029B E602               ANI     02      ;Test SYSTEM attribute bit
029D C9                 RET

                ;       PRINT FILE NAME

029E 3AB407     PRTFN   LDA     DSK     ;Print disk name
02A1 5F                 MOV     E,A
02A2 0E02               MVI     C,CONOUT
02A4 CD0500             CALL    BDOS
02A7 111205             LXI     D,COLON ;Print ": "
02AA CDD003             CALL    PRINT
02AD 2AB007             LHLD    BUFF    ;Set HL to point to current File Name
                                        ;Buffer
02B0 23                 INX     H       ;Set pointer to first file name
                                        ;character
02B1 0608               MVI     B,8     ;Set counter to number of file name
                                        ;characters
02B3 E5         NEXTN2  PUSH    H       ;Save pointer and counter
02B4 C5                 PUSH    B
02B5 7E                 MOV     A,M     ;Get file name character
02B6 E67F               ANI     7FH     ;Strip off top bit (if any)
02B8 5F                 MOV     E,A     ;Print ASCII character
02B9 0E02               MVI     C,CONOUT
02BB CD0500             CALL    BDOS
02BE C1                 POP     B       ;Recall counter and pointer
02BF E1                 POP     H
02C0 23                 INX     H       ;Increment pointer
02C1 05                 DCR     B       ;Decrement character counter
02C2 C2B302             JNZ     NEXTN2  ;Loop to NEXTN2 if more file name
                                        ;characters
02C5 E5                 PUSH    H       ;Save pointer
02C6 1E2E               MVI     E,'.'   ;Print '.'
02C8 0E02               MVI     C,CONOUT
02CA CD0500             CALL    BDOS
02CD E1                 POP     H       ;Recall pointer
02CE 0603               MVI     B,3     ;Set counter to number of file type
                                        ;characters
02D0 E5         NEXTT2  PUSH    H       ;Save pointer and counter
02D1 C5                 PUSH    B
02D2 7E                 MOV     A,M     ;Get file type character
02D3 E67F               ANI     7FH     ;Strip off top bit (if any)
02D5 5F                 MOV     E,A     ;Print ASCII character
02D6 0E02               MVI     C,CONOUT
02D8 CD0500             CALL    BDOS
02DB C1                 POP     B       ;Recall counter and pointer
02DC E1                 POP     H
02DD 23                 INX     H       ;Increment pointer
02DE 05                 DCR     B       ;Decrement character counter
02DF C2D002             JNZ     NEXTT2  ;Loop to NEXTT2 if more file type
                                        ;characters
02E2 1E20               MVI     E,' '   ;Print ' '
02E4 0E02               MVI     C,CONOUT
02E6 CD0500             CALL    BDOS
02E9 C9                 RET

                ;       PRINT EXISTING (UNCHANGED) FILE ATTRIBUTE

02EA 3AB507     PFATT   LDA     FATT    ;Get File Attribute register contents
02ED 4F                 MOV     C,A     ;Store it as a 16-bit value in BC
02EE 0600               MVI     B,0
02F0 3AAF07             LDA     ATTR    ;Get Attribute Type register contents
02F3 FE02               CPI     DIRATT  ;Is it DIR or SYS?
02F5 F2FE02             JP      PFATT1  ;Yes - jump to PFATT1
02F8 218F07             LXI     H,ATMSG1;Set HL to point to base of ATMSG1
                                        ;message pointers
02FB C30103             JMP     PFATT2
02FE 219707     PFATT1  LXI     H,ATMSG2;Set HL to point to base of ATMSG2
                                        ;message pointers
0301 CDC703     PFATT2  CALL    TBLPRT  ;Print the indicated message
0304 C9                 RET

                ;       ASK IF ATTRIBUTE IS TO BE CHANGED

0305 11E303     QCHG    LXI     D,ASK   ;Print "?   "
0308 CDD003             CALL    PRINT
030B CDD603             CALL    CHARIN  ;Get operator's response
030E FE03               CPI     03      ;Jump to EXIT if ^C
0310 CA5103             JZ      EXIT
0313 FE59               CPI     'Y'     ;Jump to CHAATT if it is "Y" or "y"
0315 CA2403             JZ      CHAATT
0318 FE79               CPI     'y'
031A CA2403             JZ      CHAATT
031D 113706             LXI     D,NO    ;Print "No"
0320 CDD003             CALL    PRINT
0323 C9                 RET

0324 2AB007     CHAATT  LHLD    BUFF    ;Set HL to point to current File Name
                                        ;Buffer
0327 110F00             LXI     D,15    ;Add 15-byte offset to point to Change
032A 19                 DAD     D       ;Status byte
032B 3EFF               MVI     A,0FFH  ;Set Change Status byte
032D 77                 MOV     M,A
032E 2AB007             LHLD    BUFF    ;Reset HL to point to beginning of File
                                        ;Name Buffer
0331 3AAF07             LDA     ATTR    ;Get attribute type register contents
0334 FE02               CPI     DIRATT  ;Is it DIR or SYS?
0336 F23E03             JP      CHAATT1 ;No - jump to CHAATT1
0339 1E09               MVI     E,09H   ;Add offset to point to READ attribute
033B C34003             JMP     CHAATT2 ;byte
033E 1E0A       CHAATT1 MVI     E,0AH   ;Add offset to point to SYSTEM
0340 19         CHAATT2 DAD     D       ;attribute byte
0341 7E                 MOV     A,M     ;Get file attribute byte
0342 EE80               XRI     80H     ;Toggle file attribute bit
0344 77                 MOV     M,A     ;Save changed file attribute byte
0345 3EFF               MVI     A,0FFH  ;Set query flag QFLAG to indicate that
0347 32B607             STA     QFLAG   ;there are files to be changed
034A 118907             LXI     D,YES   ;Print "Yes"
034D CDD003             CALL    PRINT
0350 C9                 RET
0351 111905     EXIT    LXI     D,EXMSG ;Print operator termination message
0354 CDD003             CALL    PRINT
0357 C30000             JMP     BOOT    ;Exit to CP/M

                ;       RETURN TO CP/M IF SPECIFIED FILES ALREADY HAVE DESIRED
                ;       FILE ATTRIBUTES

035A 11B606     ALLOK   LXI     D,NOFC1 ;Print "Specified files are already ..."
035D CDD003             CALL    PRINT
0360 3AAF07             LDA     ATTR    ;Get attribute type flag
0363 4F                 MOV     C,A     ;Store it as a 16-bit value in BC
0364 0600               MVI     B,0
0366 21A707             LXI     H,NOFCM ;Set HL to point to base of NOFCM
0369 CDC703             CALL    TBLPRT  ;Print the indicated message
036C C30000             JMP     BOOT    ;Exit to CP/M
```

More →

Listing 1 continued.

```
                        ;       ASK IF ATTRIBUTES OF INDICATED FILES SHOULD BE CHANGED

036F 110207     GOK     LXI     D,OKCHG ;Print "O.K. to change?"
0372 CDD003             CALL    PRINT
0375 CDD603             CALL    CHARIN  ;Get operator's response
0378 FE59               CPI     'Y'     ;Jump to CHGYES if it is "Y" or "y"
037A CA9B03             JZ      CHGYES
037D FE79               CPI     'y'
037F CA9B03             JZ      CHGYES
0382 3AAF07             LDA     ATTR    ;Get Attribute Type register contents
0385 FE02               CPI     DIRATT  ;Is it DIR or SYS?
0387 F29303             JP      GOK1    ;Yes - jump to GOK1
038A 113C06             LXI     D,NOAB1 ;Print
038D CDD003             CALL    PRINT   ;"No - READ attributes NOT CHANGED"
0390 C39903             JMP     GOK2
0393 116006     GOK1    LXI     D,NOAB2 ;Print
0396 CDD003             CALL    PRINT   ;"No - SYSTEM attributes NOT CHANGED"
0399 B7         GOK2    ORA     A       ;Set Carry Status to 0 as "NOT CHANGED"
039A C9                 RET             ;flag

039B 118907     CHGYES  LXI     D,YES   ;Print "Yes"
039E CDD003             CALL    PRINT
03A1 37                 STC             ;Set Carry Status to 1 as "CHANGED"
03A2 C9                 RET             ;flag

                        ;       CHANGE ATTRIBUTES OF INDICATED FILES

03A3 3AB307     DOCHG   LDA     DFCNT1  ;Set counter to number of directory
03A6 47                 MOV     B,A     ;files
03A7 2AB007     NEXTFC  LHLD    BUFF    ;Set HL to point to current File Name
03AA 110F00             LXI     D,15    ;Buffer's Change Status byte
03AD 19                 DAD     D
03AE 7E                 MOV     A,M     ;Check Change Status byte
03AF FEFF               CPI     0FFH
03B1 C2BF03             JNZ     NOCHG   ;Jump to NOCHG if not set
03B4 C5                 PUSH    B       ;Save file counter
03B5 2AB007             LHLD    BUFF    ;Change file attributes
03B8 EB                 XCHG
03B9 0E1E               MVI     C,SETFAT
03BB CD0500             CALL    BDOS
03BE C1                 POP     B       ;Recall counter
03BF CD2402     NOCHG   CALL    INCBUFF ;Increment File Name Buffer Array pointer
03C2 05                 DCR     B       ;Decrement file counter
03C3 C2A703             JNZ     NEXTFC  ;Loop to NEXTFC if more files
03C6 C9                 RET

                        ;       GENERAL TABLE-DRIVEN PRINT MESSAGE ROUTINE
                        ;       (HL POINTS TO BASE OF TABLE, BC IS ENTRY OFFSET)

03C7 09         TBLPRT  DAD     B       ;Add offset to table base pointer
03C8 09                 DAD     B
03C9 5E                 MOV     E,M     ;Move address of message indicated
03CA 23                 INX     H       ;by pointer to DE
03CB 56                 MOV     D,M
03CC CDD003             CALL    PRINT   ;Print the indicated message
03CF C9                 RET

                        ;       GENERAL PRINT STRING ROUTINE

03D0 0E09       PRINT   MVI     C,PSTRNG
03D2 CD0500             CALL    BDOS
03D5 C9                 RET

                        ;       GENERAL DIRECT INPUT ROUTINE

03D6 1EFF       CHARIN  MVI     E,0FFH  ;Wait for operator's response
03D8 0E06               MVI     C,DIRCIO
03DA CD0500             CALL    BDOS
03DD FE00               CPI     0
03DF CAD603             JZ      CHARIN  ;Loop to CHARIN if no response yet
03E2 C9                 RET

                        ;       *** DATA STATEMENTS ***

03E3 3F20202024ASK      DB      '?   $'
03E8 0754686520ATTERR   DB      BELL,'The command line syntax expected by '
040D 5345544154         DB      'SETATT is:',CR,LF,LF
041A 2020534554         DB      '  SETATT filename.typ (specifier)',CR,LF,LF
043E 7768657265         DB      'where (specifier) can be one of:',CR,LF,LF
0461 2020522F57         DB      '  R/W     to reset files to Read/Write',CR,LF
0488 2020522F4F         DB      '  R/O     to set files to Read-Only',CR,LF
04AC 2020444952         DB      '  DIR     to reset files to Directory',CR,LF
04D2 2020535953         DB      '  SYS     to set files to System',CR,LF,LF
04F4 652E672E20         DB      'e.g. - SETATT DONOT.ERA R/O',CR,LF,'$'
0512 3A2024     COLON   DB      ': $'
0515 44495224   DIR     DB      'DIR$'
0519 070D0A0A   EXMSG   DB      BELL,CR,LF,LF
051D 5345544154         DB      'SETATT terminated at operator''s request - '
0547 4E4F204154         DB      'NO ATTRIBUTES CHANGED',CR,LF,'$'
055F 0D0A       HEAD1   DB      CR,LF
0561 5345544154         DB      'SETATT - Version 1.0                    '
0588 2020202020         DB      '        Copyright 1983 byHeart Software'
05AF 0D0A0A24           DB      CR,LF,LF,'$'
05B3 46696C6520HEAD2    DB      'File Name:          $'
05C3 5359535445HEAD3A   DB      'SYSTEM Attribute:   Change to $'
05E2 5245414420HEAD3B   DB      'READ Attribute:     Change to $'
0601 524541442FHEAD4A   DB      'READ/WRITE?',CR,LF,LF,'$'
0610 524541442DHEAD4B   DB      'READ-ONLY?',CR,LF,LF,'$'
061E 4449524543HEAD4C   DB      'DIRECTORY?',CR,LF,LF,'$'
062C 5359535445HEAD4D   DB      'SYSTEM?',CR,LF,LF,'$'
0637 4E6F0D0A24NO       DB      'No',CR,LF,'$'
063C 074E6F202DNOAB1    DB      BELL,'No - READ attributes NOT CHANGED'
065D 0D0A24             DB      CR,LF,'$'
0660 074E6F202DNOAB2    DB      BELL,'No - SYSTEM attributes NOT CHANGED'
0683 0D0A24             DB      CR,LF,'$'
0686 07         NFMSG   DB      BELL
0687 536F727279         DB      'Sorry - specified file(s) could not be found'
06B3 0D0A24             DB      CR,LF,'$'
06B6 0753706563NOFC1    DB      BELL,'Specified files are already $'
06D4 524541442FNOFC2A   DB      'READ/WRITE',CR,LF,'$'
06E1 524541442DNOFC2B   DB      'READ-ONLY',CR,LF,'$'
06ED 4449524543NOFC2C   DB      'DIRECTORY',CR,LF,'$'
06F9 5359535445NOFC2D   DB      'SYSTEM',CR,LF,'$'
0702 0D0A4F2E4BOKCHG    DB      CR,LF,'O.K. to change?     $'
0719 2020202052PRO      DB      '    READ-ONLY             $'
0732 2020202052PRW      DB      '    READ/WRITE            $'
074B 2020202044PD       DB      '    DIRECTORY             $'
0764 2020202053PS       DB      '    SYSTEM                $'
077D 522F5724   RW      DB      'R/W$'
0781 522F4F24   RO      DB      'R/O$'
0785 53595324   SYS     DB      'SYS$'
0789 5965730D0AYES      DB      'Yes',CR,LF,'$'

                        ;       *** MESSAGE POINTER TABLE ***

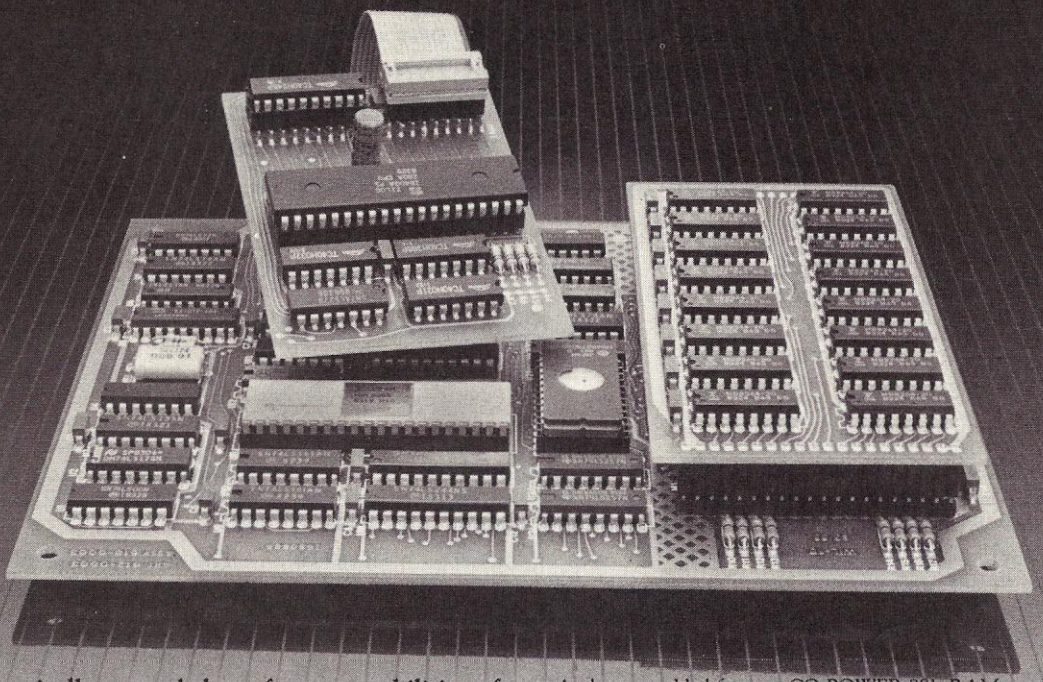
078F 4B07       ATMSG1  DW      PD
0791 4B07               DW      PD
0793 6407               DW      PS
0795 6407               DW      PS
0797 3207       ATMSG2  DW      PRW
0799 1907               DW      PRO
079B 3207               DW      PRW
079D 1907               DW      PRO
079F 0106       HDMSG   DW      HEAD4A
07A1 1006               DW      HEAD4B
07A3 1E06               DW      HEAD4C
07A5 2C06               DW      HEAD4D
07A7 D406       NOFCM   DW      NOFC2A
07A9 E106               DW      NOFC2B
07AB ED06               DW      NOFC2C
07AD F906               DW      NOFC2D

                        ;       *** RESERVED DATA AREA ***

07AF            ATTR    DS      1       ;Attribute Type register
07B0            BUFF    DS      2       ;File Name Buffer pointer
07B2            DFCNT   DS      1       ;Directory File Count register
07B3            DFCNT1  DS      1       ;Aux. Directory File Count register
07B4            DSK     DS      1       ;Specified disk name register
07B5            FATT    DS      1       ;File Attribute register
07B6            QFLAG   DS      1       ;Query flag
07B7            FFFLAG  DS      1       ;File Found Flag
07B8                    DS      8       ;4-level local stack
                STACK
07C0 =          FNBA    EQU     $       ;Beginning of File Name Buffer Array
07C0                    END
```

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Let Us Go Arraying

Logically speaking, arrays are just one of many programming constructs omitted from Ashton-Tate's dBase II, but there are ways to simulate array-like logic. Here are a couple of programming constructs that will send you away with a better understanding of dBasic II.

By J. Blake Mason

Arrays in dBaseII? Not really. Array logic is one of the many programming constructs lacking in Ashton-Tate's dBaseII programming language. This is rather unfortunate for would-be dBase programmers who are trained in Basic or Fortran and are accustomed to utilizing arrays in normal programming activities, such as processing large numbers of variables consecutively.

This article deals with two of dBaseII's more useful programming constructs that illustrate a method to simulate array-like logic. If you've never written command files in dBaseII, read on. Even if you grasp only the concepts here, you'll come away with a better understanding of dBaseII.

```
10 DIM A(10)
20 DATA 1.5, 3.5, 2.6, 7.3, 7.4, 2.3
30 DATA 4.5, 2.6, 4.8, 1.6, 1.8, 9.9
40 FOR I = 1 TO 10
50     READ A(I)
60 NEXT I
```

Fig. 1. Read Data statement with array.

Arrays are commonly used in languages such as Basic, Fortran and Pascal for file specifications, primarily to ease the task of dealing with large amounts of variables or data. In Basic, the Read Data statement is frequently used with arrays (Fig. 1).

In this example, an array called A(I) is used to hold the data read into it by the Read Data statements. It's like an eggcrate with (in this example) ten cells. The for...next loop dumps the data, piece by piece, into each consecutive cell of the array.

When I is six, for example, the data is read into the sixth cell and so on. In dBaseII, there are no arrays per se. Actually, a relational database file is an array, though never accessed in the traditional manner.

To understand array logic emulation in dBaseII, first look at the dBaseII concept of macro variables. The best way to describe a macro is by illustrating how it's used. Consider the dBaseII algorithm in Fig. 2.

After writing and executing this algorithm, a Display Memory command will show that three variables have been created with the following values:

```
STORE 5 TO NUMBER
STORE "CELL" + STR(NUMBER,1) TO TEMPCELL
STORE 7 TO &TEMPCELL
```

Fig. 2. dBaseII algorithm.

```
NUMBER      (N)  5
TEMPCELL    (C)  CELL5
CELL5       (N)  7
```

The variable CELL5 was created by the string concatenation in the second line of the algorithm. The value of CELL5 is 7. This was accomplished by use of the macro variable command "&" in the third line. Therefore, line three can be loosely defined as "store the number 7 to the value of TEMPCELL."

The value of TEMPCELL from the previous line is CELL5. This is like designating a specific cell of your actual Basic array example by the current value of I. This may seem like much ado about nothing—it is obviously easier to store 7 to a variable called CELL5 to begin with.

The benefit becomes apparent when dealing with a large number of variables and processing them in a wide variety of ways. The simplest way is to use a counter loop, as in the Basic example. In this case, rather than change the designated cell of an array by the value of the counter, change the value of the variable. Consider the dBaseII algorithm used to initialize ten variables to zero in Fig. 3.

Here, a display memory shows ten variables have been created (with the values of "CELL0" through "CELL9"); all have the initialized value of zero.

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Again, the obvious benefit is lost by the simplicity of storing zero to a variable. The line that stores 0.0 to the macro variable, however, can be a series of lines or an entire procedure in itself. This illustrates how a large number of variables are processed in a complex manner using a single version of the processing construct.

A more tangible example of the benefits associated with array-like logic is a dBaseII data file that contains an entire checking account. Suppose that one of the fields in the file is the category of the check (i.e., AMEX for American Express, CLOTH for clothing expenditures and so on).

A typical checking account contains many categories of expenditures. At the end of the month, you will probably want to subtotal each category of expediture in turn, as well as count the frequency of checks and perform some simple statistics, such as averaging the expenditures. Since this series of procedures occurs each month in exactly the same manner, it's an ideal candidate for a dBaseII command file.

You can approach the writing of the checking account processing command file as a series of tests performed upon each check to determine the proper category. In dBaseII, the if...then...else construct can be used for testing, as can a Case statement.

These constructs, however, would be lengthy and cumbersome, since each possible category of check must be written into the program and tested against each check. Moreover, if new categories are added at a later date, the program must be modified to include the new tests for that category.

Suppose instead that you create a second data file of categories. You can now use the category database to test the checks in the checking account database and to sum, add and average all categories with a single testing construct. See Fig. 4.

The algorithm in Fig. 4 is a static processing procedure of the category variables—the number of category variables is not defined by the counter loop. To add, delete or change category variables, simply append to or modify the category database, instead of modifying the program itself.

The macro variable construct can be used generously throughout the program for later printing and processing functions in the same manner, as the macro assignments are defined in a numerical sequence controlled by a counter loop. Incidently, the apparent increase in running time due to the calling of the secondary database isn't generally appreciable if the secondary data file is relatively small, say 30 or fewer records.

dBaseII has been criticized for its lack of true programming constructs, its interpreted rather than compiled program execution and its generally slow execution time for data sorts. Some shortcomings can be improved by generating program constructs with the various specialized features that Ashton-Tate provides. All things considered, it is an effective and efficient language for general databased programming applications and lends itself to introducing the novice to proper procedural programming logic. Happy dBasing.■

```
STORE 0 TO COUNT
DO WHILE COUNT ( 10
  STORE "CELL" + STR(COUNT,1) TO TEMPCELL
  STORE 0.0 TO &TEMPCELL
  STORE COUNT + TO COUNT
ENDDO
```

Fig. 3. Variables initialized to zero.

```
STORE 1 TO COUNT
SELECT PRIMARY
USE B:CHECKS *  (Checking Account File)
*
* Find first occurrence of month's check
* Note START and END dates are numeric
*
LOCATE FOR NDATE > START .AND. < END
*
DO WHILE .NOT. EOF   *(Loop through file to end)
  IF COUNT < 10
    STORE "SUM" + STR(COUNT,1) TO TEMPSUM
    STORE "NUMBER" + STR(COUNT,1) TO TEMPNUMB
  ELSE
    STORE "SUM" + STR(COUNT,2) TO TEMPSUM
    STORE "NUMBER" + STR(COUNT,2) TO TEMPNUMB
  ENDIF
  *
  *Use category data file to test
  *
  SELECT SECONDARY
  USE B:CATEGORIES
  *
  * (Note: the command to USE the secondary file
  * is not needed within a loop, if the SELECT SECONDARY
  * command was used to identify the secondary file
  * before the loop began)
  *
  * Test each category in file
  *
  DO WHILE .NOT. EOF .OR. STOP
    IF CATEGORY = FILECAT  *(field names in files)
      STORE AMOUNT + &TEMPSUM TO &TEMPSUM
      STORE 1 + &TEMPNUMB TO &TEMPNUMB
      STORE T TO STOP  *(match has been found)
    ELSE
      SKIP *(match hasn't been found)
    ENDIF
  ENDDO
  STORE COUNT + 1 TO COUNT  *(add one to counter)
  SELECT PRIMARY
  CONTINUE  *(Find next occurrence)
ENDDO
```

Fig. 4. Second data file of categories. Comments in parentheses are for readers' information only and shouldn't be typed into the computer.

A Virtual Solution

If the idea of installing CP/M on a single-drive system strikes fear in your heart, here's an inexpensive alternative to adding a second "physical" disk drive. The author explains the process and the benefits of adding a virtual drive.

By Dennis Berglund

The necessity of having a second drive recently became apparent to me when I installed CP/M on a single-drive system. I was panic-stricken when I ran out of space on the first disk. After spending several anxious moments reading the Digital Research manuals, I decided to eliminate the system deficiency by adding a *virtual* drive rather than a physical one.

The software solution is definitely cheaper and offers other benefits as well.

Although your system may already have two drives, additional virtual drives can improve your system's performance. Are both of your drives limited to the standard IBM exchange format (eight-inch, single-density, 128-byte sectors, a sector skew of six)? One or more virtual drives let you maintain exchange format compatibility while increasing disk capacity and reducing file transfer time.

With a virtual drive, you can design your own disk format. If you change the track format from 26 128-byte sectors to eight 512-byte sectors, the disk capacity increases from 250Kb to 308Kb. If you change the sector skew from six to two, you can reduce the transfer time of a 2Kb block from 359 ms to 180 ms.

If you change the first two tracks from system tracks to file tracks, you increase your file capacity up to 8Kb.

Too Good to Be True?

Although this sounds great, the skeptics are right: there are strings attached. Since everything is done in software, your BIOS gets bigger. You must frequently insert and remove disks, especially with just one drive. If your virtual drives have different track formats, you have to mark and sort those disks from the exchange format disks. In my case, I consider these minor detractions.

What Is a Virtual Drive?

When working in CP/M, all interfacing to the hardware is done in BIOS. The BDOS makes requests to logical devices for input or output by calling the appropriate BIOS routine. All of the logical (software)-to-physical (hardware) mapping is contained in BIOS. Instead of your hairdresser, only your BIOS knows if PUN: is really a paper tape punch (is that anything like a vacuum tube?).

The logical-to-physical mapping of disk drives is also performed in BIOS. BDOS selects a logical drive by calling the SELDSK routine in BIOS. It's up to SELDSK to determine which physical drive will be involved in the subsequent data transfer. A virtual drive exists only logically; it is actually mapped by SELDSK onto one of the physical drives.

BDOS gets along well dealing with logical devices. BDOS couldn't care less whether A: and B: physically exist as separate hardware drives. As long as BDOS can address them and transfer data to them, everything runs smoothly.

A virtual drive exists in BIOS in the SELDSK routine and in the disk parameter tables contained in BIOS. BIOS knows how many physical drives are present and knows the correspondence between virtual and physical drives. BIOS also knows disk parameter information, such as sectors per track and skew, for all drives.

How's It Done?

The key to creating virtual drives in a floppy system is changing disks. Let's say I have a single-drive system that has two logical drives, A and B. Suppose I want to copy a file from A to B and the source disk is in the drive. After CP/M loads the copy program, I need to know when to remove disk A and insert disk B. The computer needs to know when the change has occurred so it can proceed. When the task is complete, the prompt-response process must be repeated to return to the default A drive.

Prior to any data transfer, the SELDSK routine in BIOS gets called by BDOS to select a drive. By keeping track of the disk in the drive, SELDSK can determine when a disk change is required.

When SELDSK is called, the disk to be selected is identified by the value in register C: 0 for disk A, 1 for disk B and so on. By comparing the value representing the requested disk to a stored value of the disk currently in the drive, SELDSK can determine whether to prompt the operator for a disk change.

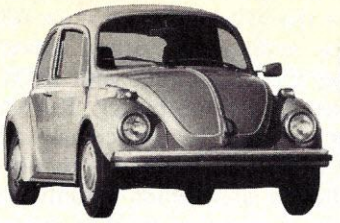
The fact that the disk change has occurred can be sensed either automatically or manually. Depending on your disk controller, you may be able to automatically sense the disk change by watching the Disk Not Ready status.

Some drives also have an optional Disk Change output that you may be able to check by reading the controller's status. The manual alternative is to wait for a keyboard entry.

The Disk Parameter Tables

As the designer of your virtual drive system, you will have to decide what

Address correspondence to Dennis Berglund, RD 2 Box 479, Frankfort, NY 13340.



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characteristics your virtual drives will have. For example, are you going to eliminate the system tracks? What sector skew will your virtual drive have? Your answers to these questions have to be put into two BIOS tables, the disk parameter block (DPB) and the disk parameter header (DPH).

The disk parameter header contains address pointers to data areas associated with a particular drive. One of the DPH entries points to the disk parameter block for that drive. Each drive must have its own 16-byte DPH.

The first entry in the DPH is the address of the sector skew table. Drives with the same skew can share the same skew table. If you change to a nonstandard skew, add a skew table to BIOS.

The disk parameter block contains information about the characteristics of each class of drive. If two or more drives have the same characteristics, they may share the same DPB. The DPB contains information like the number of 128-byte records per track, the number of directory entries and the number of allocation blocks.

What Are the Changes?

To add virtual drives, your BIOS must be changed in the following areas:

- SELDSK must be changed to add a prompt-response process. The fact that a disk has been changed can be sensed either automatically or manually.
- A DPH must be declared for each drive. Drives with different characteristics must have separate DPBs. There must be a sector skew table for each different skew you plan to use.
- Uninitialized data areas for an allocation vector and a check vector must be declared for each drive.
- If your virtual drives don't contain a copy of your CP/M system on the first two tracks, the warm boot routine must select a drive that does.

The Listing

The assembly listing (Listing 1) shows how I added a second virtual drive to a single-drive system. Both drives have the same exchange format characteristics. Only those BIOS routines and data areas that are directly involved are shown in detail.

The identity of the current disk, CDISK, is initialized in cold. Warm boots always occur from disk A, which is assured by the SELDSK call in warm. The requested disk is compared to the current disk in SELDSK to see if a disk change is required. If it is, you are asked to insert the appropriate disk.

The fact that the disk has been changed is automatically sensed in RESPON. The current disk is changed to the requested disk after the new disk is inserted. A DPH for the added drive is included (DPHB), as well as space for the allocation (ALVB) and check (CKVB) vectors. The two drives have the same characteristics, so they share the same DPB and skew table.

The addition of virtual drives requires modification of your BIOS and makes your BIOS bigger. The virtual drive concept is particularly attractive, since it allows disk format experimentation and better system performance. I may get tired of switching disks, but it sure beats not having a second drive! ■

Listing 1. Adding a second virtual drive to a single-drive system.

```
                        ;
                        ;       ADDING VIRTUAL DRIVES TO CP/M
                        ;
                        ;               DENNIS BERGLUND
                        ;
3032 =                  MONTH   EQU     '02'
3235 =                  DAY     EQU     '25'
3834 =                  YEAR    EQU     '84'
                        ;
                        ; To add virtual drives, the following BIOS routines
                        ; must be modified:
                        ;
                        ;   LABEL       CHANGE
                        ;   =====       ======
                        ;
                        ;   COLD        Initialize CDISK
                        ;
                        ;   WARM        Call SELDSK to boot from Disk A
                        ;
                        ;   SELDSK      Compare Requested to Current Disk
                        ;               Prompt for disk change
                        ;               Wait for disk change
                        ;               Set Current Disk to Requested Disk
                        ;               Return DPH address in HL
                        ;
                        ; For each additional disk, the following tables
                        ; and data areas must be changed:
                        ;
                        ;   LABEL       DESCRIPTION
                        ;   =====       ===========
                        ;
                        ;   DPH         Add 16 bytes for each disk
                        ;
                        ;   ALV         Add uninitialized data area
                        ;
                        ;   CKV         Add uninitialized data area
                        ;
                        ; If the added virtual disks have different
                        ; characteristics than the initial disk, additional
                        ; SECTOR SKEW TABLEs and DISK PARAMETER BLOCKs
                        ; will be required.
                        ;
                        ; The user must supply his own routine to determine
                        ; that the requested disk change has occurred. This
                        ; routine may be based on a keyboard entry or on a
                        ; controller 'drive ready' status check.
                        ;
003E =                  MSIZE   EQU     62      ;SYSTEM SIZE IN KBYTES
                        ;
0100 =                  TPA     EQU     0100H
002A =                  DELTA   EQU     MSIZE-20
A800 =                  BIAS    EQU     DELTA*1024
DC00 =                  CCP     EQU     3400H+BIAS
E400 =                  BDOS    EQU     CCP+800H
F200 =                  BIOS    EQU     CCP+1600H
                        ;
0080 =                  BUFF    EQU     0080H   ;DEFAULT DMA BUFFER
0004 =                  DISKNO  EQU     0004H   ;CP/M DRIVE
                        ;
000D =                  CR      EQU     0DH
000A =                  LF      EQU     0AH
00C3 =                  JUMP    EQU     0C3H    ;'JMP' OP CODE
                        ;
0002 =                  NDSKS   EQU     2       ;NUMBER OF LOGICAL DRIVES
004D =                  NTRKS   EQU     77      ;77 TRACKS: 0 TO 76
001A =                  NSECS   EQU     26      ;26 SECTORS: 1 TO 26
                        ;
00C0 =                  STATUS  EQU     0C0H    ;DISK STATUS PORT
                        ;
F200                    ORG     BIOS
                        ;
                        ; ENTRY JUMP TABLE
                        ;
F200 C3A6F2                     JMP     COLD    ;COLD BOOT
F203 C3D7F2                     JMP     WARM    ;WARM BOOT
F206 C382F3                     JMP     CONST   ;CONSOLE STATUS
F209 C383F3                     JMP     CONIN   ;CONSOLE CHAR IN
F20C C384F3                     JMP     CONOUT  ;CONSOLE CHAR OUT
F20F C385F3                     JMP     LIST    ;LIST CHAR OUT
F212 C386F3                     JMP     PUNCH   ;PUNCH CHAR OUT
F215 C387F3                     JMP     INRDR   ;READER CHAR IN
F218 C388F3                     JMP     HOME    ;SELECT TRACK 0
F21B C330F3                     JMP     SELDSK  ;SELECT DRIVE
F21E C389F3                     JMP     SETTRK  ;SET TRACK
F221 C38AF3                     JMP     SETSEC  ;SET SECTOR
```

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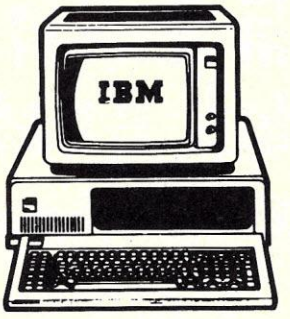
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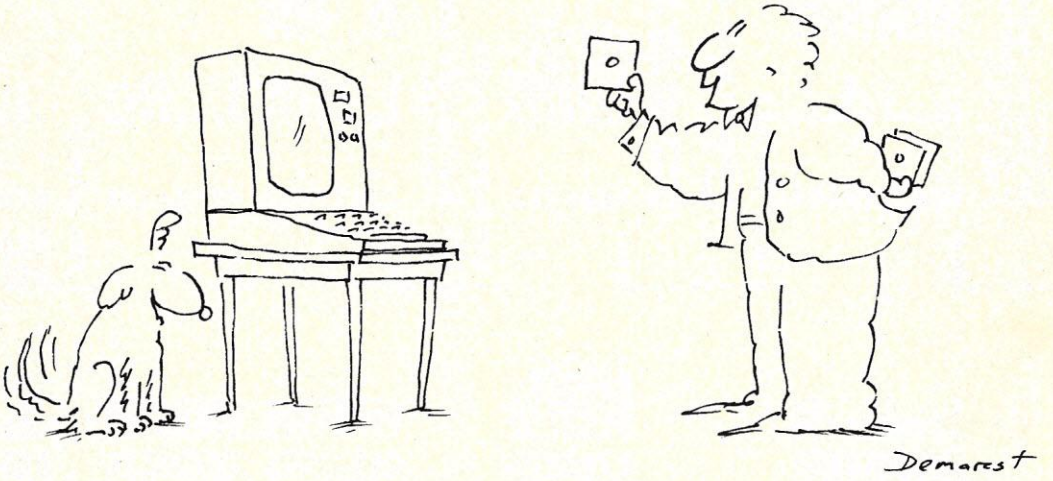
Listing continued

```
                                JMP     SETDMA  ;SET DMA ADDRESS
                                JMP     READ    ;DISK READ
                                JMP     WRITE   ;DISK WRITE
                                JMP     LISTST  ;LIST STATUS
                                JMP     SECTRN  ;SECTOR TRANSLATION
                        ;
                        ; SIGN-ON MESSAGE
                        ;
0006 =                  MI      EQU     MSIZE/10
003C =                  MITEN   EQU     10*MI
                        ;
F233 0D0A               SIGNON  DB      CR,LF
F235 3632                       DB      MI+30H,MSIZE-MITEN+30H
F237 4B204350                   DB      'K CP/M 2.2 '
F242 30322F                     DB      MONTH/256,MONTH*256/256,'/'
F245 32352F                     DB      DAY/256,DAY*256/256,'/'
F248 3834                       DB      YEAR/256,YEAR*256/256
F24A 00                         DB      0
                        ;
                        ; DISK CHANGE PROMPT
                        ;
F24B 0D0A               CHGMS:  DB      CR,LF
F24D 494E5345                   DB      'INSERT DISK '
F259 41                 WHICH:  DB      'A'
F25A 0D0A                       DB      CR,LF
F25C 00                         DB      0
                        ;
                        ; BOOT ERROR MESSAGE
                        ;
F25D 0D0A               BERMS:  DB      CR,LF
F25F 2B2B2B2B                   DB      '++++ BAD SYSTEM TRACKS ++++'
F27A 20434841                   DB      ' CHANGE DISK & RESET'
F28E 00                         DB      0
                        ;
                        ; PRINT A MESSAGE
                        ;
                        ;       Print the message pointed to by HL.
                        ;       Message ends with a 'zero' byte.
                        ;       Starts and ends with CR,LF.
                        ;
                        ;
F28F CD9CF2             PNTMG:  CALL    CRLF    ;START WITH CR,LF
F292 4E                 PNTM1:  MOV     C,M
F293 CD84F3                     CALL    CONOUT  ;DISPLAY A CHAR
F296 23                         INX     H
F297 7E                         MOV     A,M     ;MESSAGE END?
F298 B7                         ORA     A
F299 C292F2                     JNZ     PNTM1   ;CONTINUE, OR FALL THRU
F29C 0E0D               CRLF:   MVI     C,CR
F29E CD84F3                     CALL    CONOUT
F2A1 0E0A                       MVI     C,LF
F2A3 C384F3                     JMP     CONOUT
                        ;
                        ; COLD - Cold Start Routine
                        ;
                        ;       Entered from bootstrap loader
                        ;       Set page zero jumps
                        ;       Jump to CCP
                        ;
F2A6 AF                 COLD:   XRA     A
F2A7 320400                     STA     DISKNO  ;RESET CP/M DISK
F2AA 32DCF3                     STA     CDISK   ;AND BIOS CURRENT DISK
F2AD 310001             GOCPM:  LXI     SP,TPA
F2B0 018000                     LXI     B,BUFF  ;INITIALIZE DMA ADDRESS
F2B3 CD8BF3                     CALL    SETDMA
F2B6 3EC3                       MVI     A,JUMP  ;SET PAGE 0 JUMPS
F2B8 320000                     STA     0
F2BB 2103F2                     LXI     H,BIOS+3
F2BE 220100                     SHLD    1       ;SET WARM BOOT JUMP
F2C1 320500                     STA     5
F2C4 2106E4                     LXI     H,BDOS+6
F2C7 220600                     SHLD    6       ;SET BDOS ENTRY JUMP
F2CA 2133F2                     LXI     H,SIGNON
F2CD CD8FF2                     CALL    PNTMG   ;PRINT SIGN-ON
F2D0 3A0400                     LDA     DISKNO  ;GET CURRENT CP/M DISK
F2D3 4F                         MOV     C,A
F2D4 C300DC                     JMP     CCP     ;GO TO CCP
                        ;
                        ; WARM - Warm Start Routine
                        ;
                        ;       Entered from user exit to CP/M
                        ;       Reload CCP and BDOS
                        ;       Initialize page zero
                        ;       Jump to CCP
                        ;
F2D7 310001             WARM:   LXI     SP,TPA
F2DA 2100DC                     LXI     H,CCP
F2DD 22DAF3                     SHLD    DMADR   ;SET INITIAL DMA ADDRESS
F2E0 0E00                       MVI     C,0
F2E2 CD30F3                     CALL    SELDSK  ;SELECT DISK 'A'
F2E5 CD88F3                     CALL    HOME    ;GO TO TRACK 0
F2E8 3E02                       MVI     A,2     ;SKIP BOOTSTRAP LOADER
F2EA 32D9F3                     STA     SECTOR  ;SET INITIAL SECTOR
F2ED 062C                       MVI     B,25+19 ;SECTOR READ COUNT TRK 0+TRK 1
F2EF C5                 WARM1:  PUSH    B       ;SAVE SECTOR COUNT
F2F0 3AD9F3                     LDA     SECTOR
F2F3 4F                         MOV     C,A
F2F4 CD8AF3                     CALL    SETSEC  ;SET READ SECTOR
F2F7 2ADAF3                     LHLD    DMADR
F2FA 44                         MOV     B,H
F2FB 4D                         MOV     C,L
F2FC CD8BF3                     CALL    SETDMA  ;SET DMA ADDRESS
F2FF CD8CF3                     CALL    READ    ;READ A DISK SECTOR
F302 CA0CF3                     JZ      WARM2   ;READ WAS OK, ELSE...
                        ;
F305 215DF2                     LXI     H,BERMS
F308 CD8FF2                     CALL    PNTMG   ;BAD NEWS
F30B 76                         HLT             ;YOUR DEAD...
                        ;
F30C 2ADAF3             WARM2:  LHLD    DMADR
F30F 118000                     LXI     D,128
F312 19                         DAD     D
F313 22DAF3                     SHLD    DMADR   ;BUMP DMA ADDRESS
F316 3AD9F3                     LDA     SECTOR
F319 FE1A                       CPI     26      ;LAST ON TRACK 0?
F31B DA24F3                     JC      WARM3
F31E 0E01                       MVI     C,1     ;GO TO TRACK 1
F320 CD89F3                     CALL    SETTRK
F323 AF                         XRA     A       ;CLEAR SECTOR
F324 3C                 WARM3:  INR     A       ;NEXT SECTOR
F325 32D9F3                     STA     SECTOR
F328 C1                         POP     B       ;RETRIEVE SECTOR COUNT
F329 05                         DCR     B       ;ALL DONE?
F32A C2EFF2                     JNZ     WARM1
F32D C3ADF2                     JMP     GOCPM   ;FINISH UP
                        ;
                        ; SELDSK - Select Disk Routine
                        ;
                        ;       Select the disk in register C
                        ;               if C=0, then Disk A
                        ;               if C=1, then Disk B
                        ;       Return DPH address in HL
                        ;       If the requested disk is not the current disk,
                        ;               if C<>CDISK
                        ;       then
                        ;               prompt for disk change
                        ;               wait for disk change
                        ;               change current disk to requested disk
                        ;
                        ;
F330 210000             SELDSK  LXI     H,0     ;RTN HL=0, IF ERROR
F333 79                         MOV     A,C
F334 FE02                       CPI     NDSKS   ;TOO BIG?
F336 D0                         RNC             ;TOO BAD!
F337 21B9F3                     LXI     H,DPHA  ;ASSUME DISK A, FOR NOW
F33A B7                         ORA     A       ;WHICH DISK?
F33B CA41F3                     JZ      SELD1   ;RIGHT GUESS!
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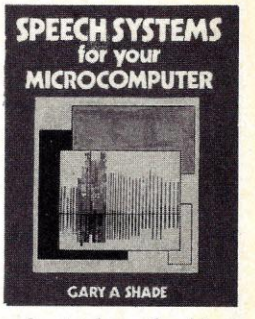
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```
F33E 21C9F3             LXI     H,DPHB  ;CHANGE TO DISK B DPH
F341 E5         SELD1:  PUSH    H       ;SAVE DPH PNTR
F342 C641               ADI     'A'     ;CONVERT NEW DISK TO ASCII
F344 3259F2             STA     WHICH   ;SAVE IN MESSAGE
F347 3ADCF3             LDA     CDISK   ;COMPARE REQUESTED TO CURRENT
F34A B9                 CMP     C       ;DIFFERENT DISK?
F34B CA5DF3             JZ      SELD2   ;NO, SAME ONE
F34E C5                 PUSH    B       ;SAVE NEW DISK
F34F 214BF2             LXI     H,CHGMS ;PROMPT FOR CHANGE
F352 CD8FF2             CALL    PNTMG
F355 CD5FF3             CALL    RESPON  ;GET RESPONSE
F358 C1                 POP     B       ;RETRIEVE NEW DISK
F359 79                 MOV     A,C
F35A 32DCF3             STA     CDISK   ;CHANGE CURRENT TO REQUESTED
F35D E1         SELD2:  POP     H       ;RETRIEVE DPH PNTR
F35E C9                 RET
                ;
                ; RESPON - WAIT AND GET USER DISK CHANGE RESPONSE
                ;
                ;       Done here automatically by checking the
                ;       Disk Ready status. Could also be done
                ;       by keyboard response.
                ;
F35F CD72F3     RESPON  CALL    DELAY   ;WAIT FOR NOT READY
F362 DBC0               IN      STATUS  ;GET DRIVE READY STATUS
F364 0F                 RRC             ;PUT READY IN CARRY FLAG
F365 DA5FF3             JC      RESPON
F368 CD72F3     RESPI:  CALL    DELAY   ;NOW, WAIT FOR READY
F36B DBC0               IN      STATUS
F36D 0F                 RRC
F36E D268F3             JNC     RESPI
F371 C9                 RET
                ;
                ; DELAY SUBROUTINE
                ;
                ;       DELAY = CLOCK*(36C+15)*B
                ;             = 4.6155B MS @ 2MHZ, C=0
                ;
                ;       MAX DELAY = 1.181 SEC
                ;
0000 =          DCNT    EQU     0       ;THE MAX!
                ;
F372 C5         DELAY:  PUSH    B
F373 010000             LXI     B,DCNT
F376 C5         DEL1:   PUSH    B       ;TIME WASTERS
F377 C1                 POP     B
F378 0D                 DCR     C
F379 C276F3             JNZ     DEL1
F37C 05                 DCR     B
F37D C276F3             JNZ     DEL1
F380 C1                 POP     B
F381 C9                 RET
                ;
                ; THE REMAINING BIOS SUBROUTINES
                ;
                ;       The other BIOS routines for your system
                ;       should be included unchanged.
                ;       They are shown as empty routines here
                ;       for completeness only.
                ;
F382 C9         CONST:  RET
F383 C9         CONIN:  RET
F384 C9         CONOUT  RET
F385 C9         LIST:   RET
F386 C9         PUNCH:  RET
F387 C9         INRDR:  RET
F388 C9         HOME:   RET
F389 C9         SETTRK  RET
F38A C9         SETSEC  RET
F38B C9         SETDMA  RET
F38C C9         READ:   RET
F38D C9         WRITE:  RET
F38E C9         LISTST  RET
F38F C9         SECTRN  RET
                ;
                ; DISK PARAMETER BLOCK
                ;
                ;       Standard 8" Single Sided Single Density
                ;       26 Sectors
                ;       128 Bytes per Sector
                ;       64 Directory Entries
                ;       2 System Tracks
                ;
F390 1A00       DPBLK:  DW      26      ;128 BYTE RECORDS/TRACK
F392 03                 DB      3       ;BLOCK SHIFT
F393 07                 DB      7       ;BLOCK MASK
F394 00                 DB      0       ;EXTENT MASK
F395 F200               DW      242     ;MAX ALLOCATION BLOCK NUMBER
F397 3F00               DW      63      ;DIRECTORY ENTRIES
F399 C0                 DB      0C0H    ;ALO: INIT. ALLOCATION VECTOR
F39A 00                 DB      0       ;AL1: INIT. ALLOCATION VECTOR
F39B 1000               DW      16      ;CHECK VECTOR SIZE IN BYTES
F39D 0200               DW      2       ;OFFSET: RESERVED TRACKS
                ;
                ; SECTOR SKEW TABLE
                ;
                ;       Standard 8" Single Sided Single Density
                ;       Skew of 6
                ;
                ;       Another skew table should be included
                ;       if the second disk is nonstandard.
                ;
F39F 01070D13   TRANS:  DB      1,7,13,19
F3A3 19050B11           DB      25,5,11,17
F3A7 1703090F           DB      23,3,9,15
F3AB 15020808           DB      21,2,8,14
F3AF 141A0C06           DB      20,26,6,12
F3B3 121B0410           DB      18,24,4,10
F3B7 1016               DB      16,22
                ;
                ; DISK PARAMETER HEADERS
                ;
                ;       There must be a separate DPH for each
                ;       logical disk.
                ;
F3B9 9FF3       DPHA:   DW      TRANS   ;SKEW TABLE POINTER
F3BB 0000               DW      0       ;BDOS WORK AREA
F3BD 0000               DW      0
F3BF 0000               DW      0
F3C1 DDF3               DW      DIRBF   ;DIRECTORY BUFFER POINTER
F3C3 90F3               DW      DPBLK   ;DISK PARAMETER BLOCK POINTER
F3C5 7CF4               DW      CKVA    ;CHECK VECTOR POINTER
F3C7 5DF4               DW      ALVA    ;ALLOCATION VECTOR POINTER
                ;
F3C9 9FF3       DPHB:   DW      TRANS
F3CB 0000               DW      0
F3CD 0000               DW      0
F3CF 0000               DW      0
F3D1 DDF3               DW      DIRBF
F3D3 90F3               DW      DPBLK
F3D5 A8F4               DW      CKVB
F3D7 8CF4               DW      ALVB
                ;
                ; BIOS VARIABLES
                ;
F3D9 01         SECTOR  DB      1
F3DA 8000       DMADR:  DW      BUFF
F3DC 00         CDISK:  DB      0
                ;
                ; BIOS SCRATCH RAM
                ;
F3DD            DIRBF:  DS      128     ;COMMON DIRECTORY AREA
F45D            ALVA:   DS      31      ;DISK A ALLOCATION VECTOR
F47C            CKVA:   DS      16      ;DISK A CHECK VECTOR
F48C            ALVB:   DS      31      ;DISK B ALLOCATION VECTOR
F4AB            CKVB:   DS      16      ;DISK B CHECK VECTOR
                ;
F4BB                    END
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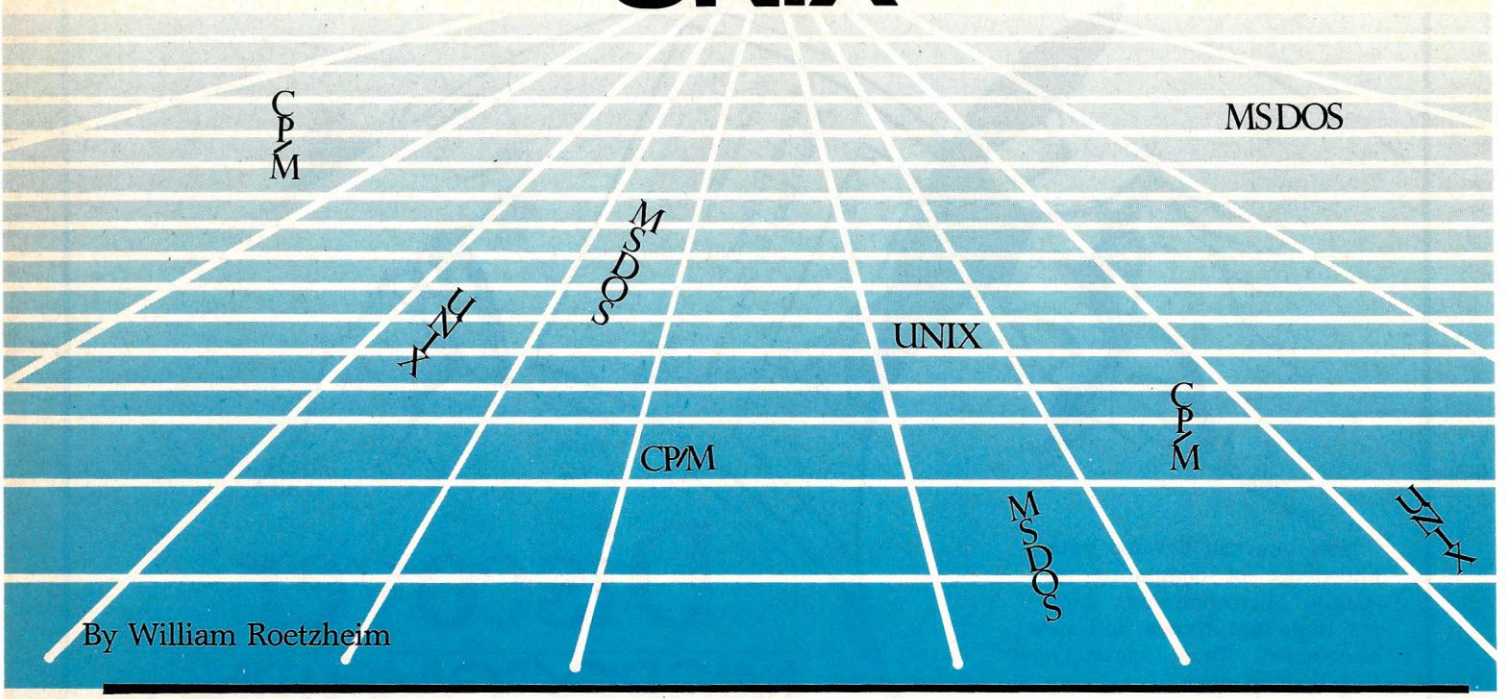
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What's the Big Deal About UNIX?



By William Roetzheim

As senior system analyst for a large system house, I've found that my friends, my conversations and even my leisure activities revolve around computers in one form or another.

Over the years it's become clear that most subjects that interest me have something to do with computers (not all, but most). Lately, however, it seems that the subject on everyone's tongue is this "new" operating system, Unix.

Everyone seems to believe that Unix is becoming the one and only significant operating system for micro- and minicomputers. The funny thing is that when I ask people why this is so, or ask for a concise description of Unix, I get blank stares and shoulder shrugs.

If Unix is so important, why doesn't anyone know anything about it? I even bought and read a couple of books and Unix-oriented magazines hoping to clear up the mystery. No way! It appears that all Unix-related material assumes you're a computer user attempting to figure out a Unix operating system (OS) that's already installed or that you're a Unix system programmer interested in some technical tidbit about some foreign-sounding routine in Unix.

After reading more than a dozen Unix-related books and spending hours talking to Unix users, I finally began to grasp the importance of this operating system. Rather than make you go through the same process, I'll try to give you a general understanding of the basic features of Unix.

This article is geared toward the reader who has a reasonable computer background but little or no knowledge of Unix. I hope to show the amazing power, versatility and potential of this unique operating system. At the very least, you'll have a better understanding of the "in" subject in computer circles.

I planned to compare CP/M with Unix but decided that was like comparing the features of a passenger car with those of a Boeing 747. Unix was designed to be used in a multi-user, multitasking environment requiring a full-featured operating system, while CP/M was designed to be a single-user, single-tasking operating system with very few special features to minimize memory space used by the OS.

The First

Microcomputer users accept the concept of somewhat portable operating systems (CP/M, MS DOS, UCSD p-System), but are definitely not used to the powerful OS packages found on most minicomputers. Minicomputer users are used to powerful OS packages but not to portable operating systems.

Unix is the first system to combine the power and utility of a minicomputer-type OS with the portability of a microcomputer OS. Because Unix isn't the product of a computer manufacturer (at least it wasn't when it was developed), the system isn't written to force users to remain within a specific manufacturer's product line.

Unix includes all of the features that minicomputer users have come to expect (and then some), yet it works well on systems having as little as 128Kb of main memory, typically occupying about 65Kb of such a system.

The Unix package usually includes:

- a C compiler and debugger
- a Fortran 77 compiler with utilities to convert from Ratfor to Fortran
- a Snobol interpreter
- compiler construction aids
- optional support for a number of other languages, including APL, Basic, Cobol and Pascal
- approximately 500 utility programs, including text editors, electronic mail programs, graphics support programs,

program development aids and many others

- a shell program allowing easy execution of all Unix utilities.

The Unix kernal is a small set of routines that are the heart of the Unix system. The kernal, written in a combination of assembler and C, is used for all input/output and for overall CPU control.

The Unix kernal is multitasking, multi-user and multilingual. Multitasking allows several programs to run at once; multi-user allows several users to use the system at once; and multilingual allows users to write or execute programs in a variety of high-level languages concurrently.

The Unix system separates program code segments from program data segments. This process is extremely important in a multitasking environment because it lets the system keep one copy of a program's code in memory with several tasks or users each using the same code segment.

The Layered Look

The Unix system can be divided into four layers. From innermost to outermost, they are: the Unix kernal, Unix system utilities, the Unix shell and user processes. These layers are shown in Fig. 1.

All actual user applications in Unix are carried out by processes. Each process consists of four segments:

1) A text (or code) segment, which may be shared among several users and cannot be modified.

2) A data segment, which contains both program data (initialized to a set value) and program variables (initialized to zero).

3) A runtime stack, which allows each process to operate independently of other processes.

4) A system segment, which is used to hold system data local to a particular process.

A process is similar to an application program, but one application program may simultaneously exist as several different processes if several users are executing the same code segment.

Any user process may be run in background on the Unix system, normally with the addition of an ampersand to the command that begins the process. When you specify that a process be run in background, Unix tells you the process identification number (PID) assigned to your process. You may use this PID and the Process Status (PS) command to check on the current status of a process, or use the PID with the Kill command to terminate a background process.

The Unix shell is a command language that allows you to make convenient use of the available Unix utility programs for your own specific applications. The shell command language supports features such as named variables, program loops (If...Then, While, and so on), subroutines, parameter passing and interrupt handling.

Using the CHMOD command, you can define a file of shell commands as executable. Thereafter, simply typing the filename will cause the execution of the entire defined file's commands. This technique is often used to define your own operating system commands.

Unix system utilities are written to perform specific narrow applications and use calls to the kernal as required. Utilities are written in C and are quite portable from one computer to another. Let's look at some interesting utility programs available under Unix.

Unix System Utilities

No article can possibly cover all of the utility programs available under Unix, so I'll summarize a few of the useful or interesting utilities. One point of interest is that the Unix system comes with a complete on-line help facility that documents all available utilities.

The Unix system includes a complete set of utilities to facilitate text editing (word processing). Some examples of the text-processing facilities available include:

- ED, a complete line editor with features such as global substitution, insert, delete, move text and transpose text
- NROFF, a document formatting package with automatic pagination, various printing styles, automatic hyphenation, various line spacing, automatic centering and underlining and the ability to define macros (user-defined formatting commands)
- TROFF, the equivalent of NROFF designed to output to a typesetter
- MS, a document preparation package with section and paragraph headings, footnotes, titles and cover sheets
- COL, used for multiple column documents
- Spell, a spelling checker program
- TBL, a table layout utility.

Unix also includes a complete set of program development utilities. Two of the most fascinating are actually used for software maintenance (that dreaded subject). As you probably know, most well-written, complex programs are written in a modular fashion. The routines from one module are often used in numerous other modules. Unfortunately, when you try to change one module of a complex

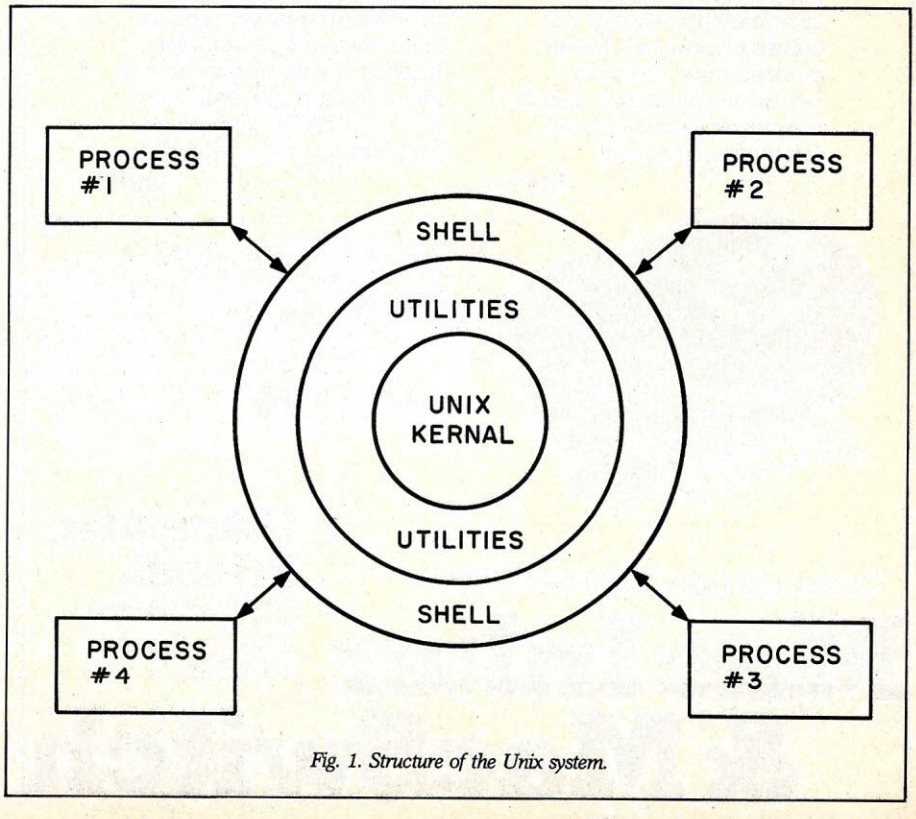


Fig. 1. Structure of the Unix system.

program, a ripple effect generates very unpredictable bugs in totally different program modules.

Make is a utility that program authors can use to automate the process of revising modules. As each module is written, the relationship of each submodule is determined and saved in a summary file. From then on, if a program module changes, the Make utility will go through all modules that use the changed module and reprocess them.

Source Code Control System (SCCS) is used to control and document text files (either program or document) by setting up something similar to an audit trail. A working source code file is often modified several times by several different people. Soon the original code is irretrievably lost and the new code may not work properly.

With SCCS, only authorized persons are permitted to modify the source code, and all changes are permanently documented. Even better, SCCS can actually be used to recover earlier versions of the source code by reversing the changes.

While most people agree that Unix utilities associated with text processing and program development are the strength of the operating system, Unix also comes with numerous unrelated utilities. Among the more interesting are:

- Write—allows various system users to communicate with each other
- Mail—an electronic mail network
- At—allows the delayed execution of a program or delivery of a message
- Encrypt—encrypts your files using a key you select.

Although I've touched on only a few of the many utility programs available, you should begin to appreciate the broad depth of this operating system. Perhaps even more interesting than the utilities themselves is the way Unix lets you connect these various utilities to each other using pipes and filters.

Pipes and Filters

Unix is the first operating system to use pipes and filters. A pipe is an operating system connection from one utility program to another that allows the output from one program to become the input to another program. Both programs then run at once, although the speed of the second program is dependent upon the rate of data output from the first program.

Only authorized persons are permitted to modify the source code, and all changes are permanently documented.

If the output from one utility is sent to two other utilities at once, the connection is called a tee. Picture several utilities all connected by pipes; the utilities themselves are called filters. A filter is a program that manipulates a data stream and then passes the data on to another utility.

Pipes are also used to send a utility's output directly to a disk file rather than to your terminal. Because all Unix files are set up as a simple string of bytes with no internal file structure imposed by the operating system, a program doesn't need to know where its output is sent.

File Dos and Don'ts

The Unix system doesn't force any internal structure file. It doesn't distinguish between sequential, random or indexed files, doesn't insert file delimiters, doesn't force records to be a set number of bytes in length, and so on.

Of course, any of these features may be implemented using an application program. One other file management feature that Unix doesn't implement is any sort of file locking. It's quite possible for two users to open the same file at the same time, and the operating system has no features to prevent both users from walking all over each other within the file.

A strong feature of Unix's disk operating system is the implementation of a hierarchical directory structure. Microcomputer users with a hard disk have seen the difficulties that can arise with one logical disk directory containing hundreds or thousands of directory entries.

This problem is more severe on multi-user systems than on single-user systems. Within Unix, you're given your own disk directory (home directory). You may then create as many subdirectories as you choose and may even create sub-subdirectories.

Although the same filename can't be used twice within any one directory, it's quite possible to have the

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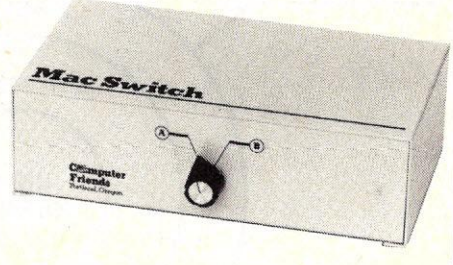
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same filename in each of several directories. You may also name the same file with several different names within the same directory.

When the Unix system is instructed to write to a file, it searches the current directory to determine if the file already exists. If a file doesn't exist, one is created. If a file does exist, it's destroyed and then recreated. Some versions of Unix include an option called noclobber that prevents the system from automatically destroying an existing file to create a new one.

Each file that's created has an identifier attached to it. Individual users may be segmented into several groups of users, and each user is considered to be part of his group. The file identifier has a bit that gives read permission, another that gives write permission and another that gives execute permission.

Unix implements three of these bit sets per file. The first set determines the status for the file owner, the second set determines the status for the members of the owner's group and the third set determines the status for all other system users.

Unix Summary

Unix is a powerful operating system for minicomputers or advanced microcomputers. Perhaps the greatest strength of Unix is that the operating system is written in C. This makes it easy to maintain (and thus very reliable) and easy to transport from one computer to another. Programs that run on one computer under Unix can usually be transported to other computers running Unix and can run with little or no modification.

The Unix operating system does, however, have some weaknesses. Among the more serious are:

- lack of virtual memory
- lack of any logical cache buffering scheme
- lack of built-in file locking procedures
- lack of a provision for priority timed interrupts. Any application that requires regular operating system interrupts (instrument control, for example), will probably not run well under Unix.

History of Unix

In 1968 Ken Thompson and Dennis Ritchie were working at Bell Laboratories on a program called Space Travel. The only computer available with the required speed was a cast-off PDP-7 with no operating system. They wrote the first version of Unix for their own use.

This early version of Unix supported two users, a limited directory hierarchy, processes and a limited editor. The name Unix was coined as a takeoff on the Multics operating system on which Bell Labs had just stopped work.

In late 1970, a PDP-11 arrived at Bell Labs. Thompson and Ritchie convinced Bell Labs to let them transfer Unix to the new computer by promising to set the system up as a word processor for the Bell Labs patent office. When Thompson and Ritchie completed the transfer in November 1971, the patent office began using the new system. At this time the first Unix manual, written by Thompson and Ritchie, was also released.

In June 1972, the second edition of Unix, still written in assembler, was released. This edition was significant in that it incorporated pipes. Ritchie began work on a derivative of the language B, which he called C.

In May 1975, Unix was rewritten in C. This version, called version 6, was available to educational institutions for a nominal fee. By 1979 Unix had been rewritten yet another time to facilitate translation from one computer to another. This version, called version 7, was the first version to be sold commercially by Bell Labs.

Since that time Unix version III and version V (the current version) have been released, and Unix shows every indication of becoming the small computer operating system of the '80s. By the way, Unix is still used throughout Bell Labs, including use by the patent office for text processing. ■

Address correspondence to William Roetzheim, 3891 American Ave., La Mesa, CA 92041.

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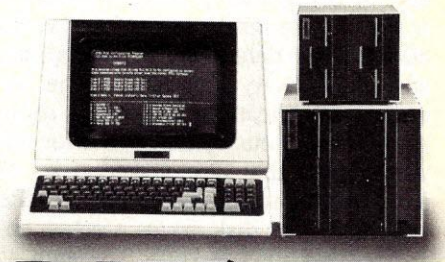
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Making Tracks

There are times when standard 35-track Apple disks just don't cut it. This article details the steps necessary to create bootable 40-track Pascal disks with 320 blocks, a sizable increase over the old 280-block format.

By Ted Carnevale

The chief advantage of Apple Pascal is that it's a reasonably complete p-System implementation of Pascal. Its most serious restrictions are due to the limited memory and disk storage space available on the Apple II Plus, IIe and compatible machines like the Franklin.

Memory limitations can be circumvented by system swapping, program segmentation and chaining. Disk space can be managed more efficiently by using source code "include" files and precompiled p-code units. These methods are discussed in the *Apple Pascal Language Reference Manual* and its addendum and are further clarified through occasional articles in the microcomputing press. It's also possible to reclaim a block of otherwise unused memory with a clever programming technique.

Although these are useful techniques, there are times when the capacity of the standard 35-track, single-sided Apple disk just isn't adequate. Until now, the only way to increase disk storage capacity was to resort to hard disks or double-sided drives, which are too expensive for many users.

The 35-track limitation is unrealistic for 5¼-inch disks. Several manufacturers offer 40-track, single-sided disk drives at a price comparable to that of standard 35-track drives. Basic programmers have long had the advantage of being able to modify DOS 3.3 to enable it to initialize, read and write 40 tracks of data. This increases disk storage capacity by 20Kb. The required modifications appear in some of the ubiquitous lists of pokes for the Apple, and they are provided by at least one manufacturer along with the purchase of its disk drives. Certain enhanced versions of DOS 3.3, such as DiversiDOS, include a 40-track formatting option that doesn't require you to invoke the monitor or to do any poking at all.

This alternative is now open to Apple p-System users. This article outlines the steps to follow to create bootable 40-track Pascal disks with 320 blocks, a 14 percent increase over the old 280-block format. It was developed for use with Apple Pascal version 1.1 that runs on the Apple II Plus, IIe, Franklin and similar microcomputers.

As I'll discuss below, the uniformity and internal consistency of the p-System make it relatively easy to implement this alternate disk format. However, it works only with drives that are mechanically capable of accessing 40 tracks. It won't work with standard 35-track disk drives, such as those made by Apple. Manufacturers of 40-track drives for Apple include MicroSci, Quentin and Rana.

Connected Possibilities

Blank disks are prepared for data storage by formatting. The most direct approach to generating 40-track disks is to change the program that does the formatting. The formatter utility provided with Apple Pascal produces a standard 35-track disk with 280-block capacity. Source code for this program isn't provided. Modifying this program to allow alternate formats involves a major effort, including tedious disassembly.

I've been using a 40-track enhanced DOS 3.3 for word processing and data communications for some time. I was almost reconciled to the 35-track limit for Apple Pascal when several disconnected facts from various sources began to fit together as the basis for implementing a 40-track format.

The way Apple disks store data is determined primarily by the characteristics of the Apple's disk controller card. Because of the peculiarities of this card, the DOS 3.3 format uses 16 sectors per track—each sector contains the equivalent of 256 bytes encoded in a special representation. Each sector is separated from its neighbors by a group of bit patterns, used for data synchronization, called sync fields.

The same encoding and synchronization techniques are used for Apple disks written under DOS, CP/M or the p-System. At least one powerful collection of Apple disk utilities (with the unprepossessing name of Bag of Tricks) appears to capitalize on this fact for the purpose of reading and writing raw data in disks prepared by all three operating systems. This fact suggested that I could format a 40-track disk using DOS and then modify the disk so it was usable by the p-System.

Formatting Process

At its most elementary level, the formatting process involves creating an orderly pattern of sync fields and sectors on each track. This is accomplished in DOS 3.3 by the Init command. This command also writes DOS into tracks 0–2, generates a bit map of allocated disk space and saves a sign-on program that is invoked at every cold boot.

To modify DOS 3.3 so that it formats, reads and writes 40-track disks, it's most convenient to use the monitor to change the contents of three memory locations, as shown here (see the *Apple II Reference Manual* for further information about using the monitor):

1) Boot a standard DOS 3.3 disk.
2) Enter the monitor by CALL -151 and change these three locations:
- AEB5: A0 to increase the size of the bit map so that it includes the sectors in tracks 35–39.
- B3EF: 28 (hexadecimal) number of tracks on the disk.
- BEFE: 28 (hexadecimal) number of tracks on the disk.

3) Return to Basic with the monitor command 3D0G.

The Init command now creates 40-

track DOS 3.3 disks. These are bootable and can be used to create additional DOS 3.3 disks without further recourse to the monitor. Even if you never use DOS 3.3 for anything else, put at least one of these 40-track DOS disks aside so you can format new 40-track disks if necessary later on.

It's my understanding that using a 40-track DOS on a 35-track disk drive may destroy the data stored on disk when attempting to access tracks 35–39. It didn't seem reasonable to attempt to verify this statement. Also, a 40-track DOS shouldn't be used to write to a disk that was formatted with 35 tracks. At the very least, an I/O error may occur when unformatted tracks 35–39 are accessed, since DOS will find no sync fields. However, I've been able to read data from 40-track disks after booting with a 35-track DOS. Presumably, DOS does not perform a range check on track numbers when reading a file.

Basic and unprotected DOS 3.3 utilities don't seem to care how many tracks there are. Franklin's powerful disk utility, FUD, works perfectly, for example. It's also possible to trick some protected programs to run under a 40-track or otherwise modified DOS.

Converting to a p-System Disk

The next step in generating a 40-track p-System disk is to copy the bootstrap tracks from a standard Pascal disk. This is done with the Formatter program on volume APPLE3:. Assuming you have a two-drive system, put APPLE3: in the second drive (which the p-System calls drive 5) and execute APPLE3:FORMATTER. Remove APPLE3: from drive 5, insert a 40-track DOS 3.3 disk and instruct the formatter to format disk 5. Refer to the *Apple Pascal Operating System Manual* (pp. 184–186) for details on use of the formatter.

The formatter writes the p-System bootstrap loader onto tracks 0 and 1. Without the bootstrap loader, a disk can't be used to boot the p-System. The formatter also overwrites tracks 0–34 with the same basic pattern of sync and data fields that was created by the DOS Init command, thereby eliminating the sign-on program and the DOS directory. Tracks 35–39, which were formatted by DOS, are left unchanged.

After exiting the formatter, call up the filer and invoke its Zero command, answering its prompts as listed here (your responses are in boldface):

```
Zero dir of ?                          #5
Destroy BLANK: ?                       Y
Duplicate dir ?                        Y
Are there 280 blks on the disk ?
(Y/N)                                  N
# of blocks on the disk ?              320
New vol name ?                         BLANK40:
BLANK40: correct ?                     Y
BLANK40: zeroed
```

Then use the filer to get a listing of the contents of disk 5 to verify that it holds 310 unused blocks and has the volume name BLANK40:.

I prefer the additional security of having a duplicate directory. This uses only six blocks of space and is probably worth it. My choice of volume name is strictly for the sake of clarity and convenience. As soon as I put some files on a BLANK40: disk, I change its volume name to something more descriptive. For example, my standard boot disk, which contains all the files from APPLE1:, is called AP41:.

Utility and Compatibility

The importance of 40 extra blocks becomes clear when you consider the typical two-drive configuration. The disk in drive 5 usually has a file called SYSTEM.COMPILER that takes up 75 of its 280 blocks. Worse yet, drive 4 usually contains APPLE1:, with all but 71 blocks occupied by system files, including the editor, filer and library. An extra 40 blocks on each of these disks represents an actual free-space increase of 20 percent and 56 percent, respectively. If your work files aren't too long, you can move the compiler onto APPLE1: (leaving 36 blocks for WRK.TEXT and WRK.CODE), and use all of the space on the disk in drive 5 for your own text and code files.

Whenever alternate disk formats are used, the question of compatibility comes up. The first concern is simply a mechanical one: don't try to access 40 tracks with a drive that is physically incapable of reading or writing beyond track 34.

Software compatibility is a more complex issue and is a function of the operating system that's being used. As I pointed out earlier, the 35-track version of Apple DOS 3.3 can read data from 40-track DOS disks. This is because disk read operations are governed by the disk directory, which instructs DOS to access whatever tracks hold data. However, standard DOS routines cannot write any data onto tracks 35–39 unless DOS has been modified so that it knows these tracks exist.

Things are much simpler under the p-System. Except for the increased storage, the 320-block format is entirely compatible with the old 280-block format. This is directly traceable to the philosophy underlying the p-System's design.

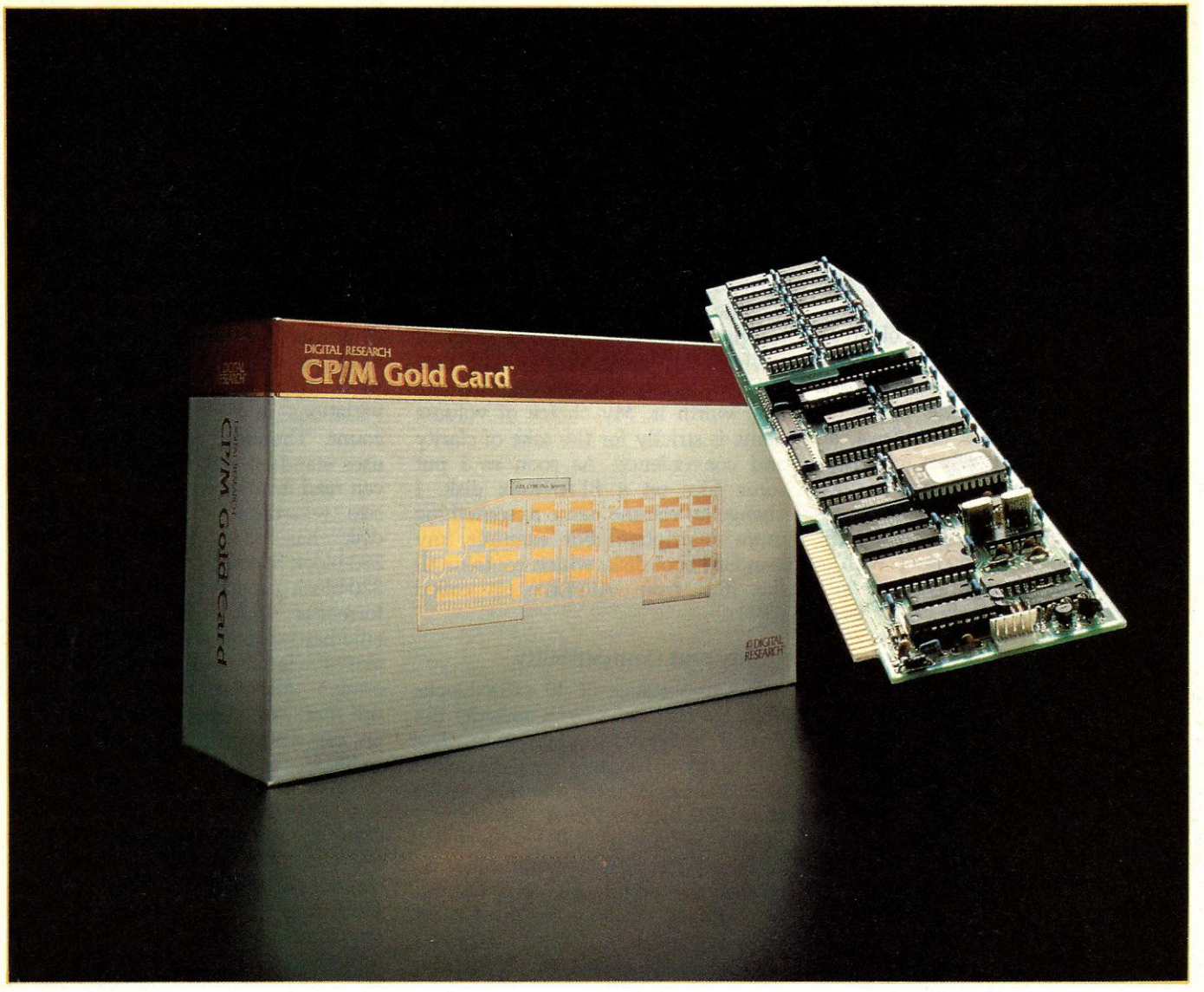
Unlike Apple DOS, the p-System was devised to run on a wide variety of hardware configurations. It doesn't need to be patched to handle disks with a different number of blocks. Its disk input/output routines apparently determine the capacity of each disk from its directory, so all read and write operations automatically take variations in disk capacity into account. Therefore, any program that uses standard p-System disk routines can read from or write to a disk of any size, regardless of whether the boot disk has the standard 35-track, 280-block capacity, or the 40-track, 320-block capacity instead. Only the formatter, which was written for specific hardware (the old 35-track Apple drives), is limited to 35-track operation. All other utilities, including the filer, compiler, assembler and so on, can access 40 tracks just as easily as 35.

Many of the filer's commands ask you where to start or end activity, citing the number of the last block on the disk. For example, the Krunch command asks "From End Of Disk, Block nnn ? (Y/N)". Apple's manuals are full of warnings that the value of nnn should never be anything other than 280. However, the p-System is smart enough to know that your 40-track disks hold 320 blocks, and all such prompts reflect the true capacity of whichever disk format you use.

I use 40-track disks for all DOS and Pascal applications. The only time I bother with 35-track disks is when it's necessary to send a disk to someone whose drives can't handle 40 tracks. Under DOS, this requires booting a 35-track disk before invoking a file copy program. With the p-System, the filer can transfer files to a 35-track disk without having to boot Pascal from a 35-track disk first.

Using the additional 40 blocks provided by tracks 35–39 isn't the ultimate answer to Apple Pascal's disk storage problems, but it adds that extra bit of space you need for one more utility, another program revision or more data. Best of all, it costs nothing if you already have 40-track disk drives!■

Address correspondence to Ted Carnevale, 10 Bancroft St., Setauket NY 11733.



Apple CP/M Cards: What's the Best Deal?

There comes a time in every Apple II owner's life when he considers adding CP/M to his system. This article compares five CP/M cards, including the new Gold Card from Digital Research, Inc.

By Keith Thompson
Editor-in-Chief

Sooner or later, an Apple II owner is likely to consider adding CP/M to his computer. This might be desirable either because the user is accustomed to CP/M by using such an operating system at work or because the user wishes to avail himself of the thousands of additional software possibilities opened up by the capability of running under CP/M.

In addition to the Z80 coprocessor, some of these add-on boards offer other hardware and programming enhancements. Each of the available cards has its own personality, as it were, depending on what secondary uses a user may have. To the ranks of CP/M cards that have been offered over the past few years is now added another flavor. It is made by Digital Research, Inc., the creator of CP/M. The company's new product, called the CP/M Gold Card, is its first hardware product. In this article, I'll examine the features of each of the major CP/M cards. With so many cards on the market, what distinguishes one from another?

The CP/M Gold Card

This card is the new entry into the CP/M card marketplace. For the dedicated CP/M user and programmer, this card is worth serious consideration. The DRI Gold Card is the only all-in-one card. It comes fully equipped with not only 64Kb RAM and a CP/M real-time clock, but with a hardware 80-column display. All of the other cards require peripherals to maximize their use, such as an 80-column card and, with some of them, additional memory cards. With Gold Card, you don't have to be concerned about what other related cards will or will not be compatible with each other within the Apple.

In addition, this card can save limited slot space with its multifunctionality. The card can be purchased with 64Kb RAM (in a nonbanked CP/M Plus system) or with 192Kb RAM (in a banked CP/M Plus system). An optional add-on card can upgrade a 64Kb card to the 192Kb version. The additional 128Kb RAM provides a disk cache operation, which means significantly faster operation of many programs. The cache keeps a copy of the most recently used random data in its memory. This reduces the number of disk accesses required for many types of applications.

The software provided is the latest CP/M Plus (version 3.0) plus CBasic. The four disks supplied include complete system utilities and assembler tools. Also included on the system is a help utility. When this is called, the screen displays information on all system commands and options. It saves quite a bit of time when you're unsure of a command sequence.

The card also incorporates a CP/M real-time clock. It will date and stamp files to indicate when a particular file was created or last modified. The hashed directory search uses hash tables to increase directory searching speed by locating directory sectors without searching the actual directory. A useful utility for the Apple II user is a program called Newkey. The program allows you to reconfigure your keyboard to suit any particular need.

There are two loose-leaf volumes filling over 700 pages to accompany the Gold Card. One contains a Gold Card and CP/M user's guide and CBasic reference manual. This volume will suit most users. The second volume contains technical information for the programmer—a programmer's guide, utilities guide and symbolic instruction debugger reference manual. Any back-up help required has the benefit of the DRI organization.

This is a well thought out package for the serious Apple CP/M programmer. DRI has done its homework in its evaluation of other CP/M cards to discover what features should be built into the "ultimate" card. This product isn't everything to everybody, however. The on-board features, such as the 80-column board and RAM and clock/dater, cannot be shared by DOS 3.3 or Pascal. If you run DOS or Pascal, you'll need a standard 80-column display card in a separate slot. If you find that you only utilize 80 columns under CP/M, you'll be relieved with this card, though, because it totally eliminates any question of compatibility between CP/M card, display card and language card. Also note that, unlike some other CP/M cards, the Gold Card's RAM cannot be accessed except under CP/M.

SoftCard

The best-known CP/M card for the Apple II is the SoftCard made by Microsoft. This card was the first to come out for the Apple and it opened up thousands of CP/M-based programs to Apple owners. It has become the compatibility standard for programmers adapting or writing software to run under the Apple II CP/M environment.

The SoftCard is for the neophyte CP/M user as much as for the advanced programmer. The card, unlike the Gold Card, has no extended hardware capability, such as an 80-column display or on-board RAM. The CP/M-80 (version 2.2) that is supplied will run as a 44Kb system on a 48Kb computer or as a 60Kb system if the Apple has a language card or Microsoft RAMCard. Other 16Kb RAM boards may not work with SoftCard. If 80-column display is desired or required, it must be placed into a separate slot.

What distinguishes this card from some of the others is not its CP/M capability as much as Microsoft Basic and GBasic, which are both included on the system disk. It is the best way for Apple owners to use and program industry-standard Microsoft Basic on the Apple II.

Software options for the SoftCard are the other Microsoft languages—Fortran, Cobol, and the Basic compiler and assembly language system. This is definitely the card for those who want to learn or program in these languages. Of the numerous utilities included with SoftCard, two that are particularly practical are Autorun and Download. Autorun turns the CP/M system into a turnkey system. For example, by simply keying AUTORUN WS, the disk will set up so that WordStar runs automatically any time you boot with that disk. The other utility (for advanced users only) allows you to transfer CP/M files from another CP/M system via an RS-232C serial data link. Once mastered, this utility has unlimited possibilities.

SoftCard comes with a single volume of documentation. The loose-leaf manual is almost 500 pages long. Characteristic of Microsoft, the documentation is logically organized and easy to follow. Both the operation manual and the Microsoft Basic reference manual are written for users at all levels. For the CP/M newcomer, Microsoft also includes another book, the Osborne CP/M user's guide, which contains special sections for SoftCard owners.

The SoftCard has a lot in its favor. By nature, it is not as technical as the Gold Card, but not everyone needs the Gold Card's in-depth features and comprehensive technical documenta-

The Appli-Card is one of the most versatile of the CP/M cards... it offers some unique features that benefit Apple DOS users.

tion. SoftCard should be considered by the neophyte or intermediate CP/M user who wants to do more than just run CP/M applications. Microsoft Basic and other special utility programs make the choice between this card and any other a difficult one.

Beware, however. Because the card has no other hardware features, you may have to make an additional investment in an extended memory card. Many CP/M applications, such as WordStar, require more memory than SoftCard by itself can provide. You will also want an 80-column display.

Appli-Card

The Appli-Card, manufactured by Personal Computer Products, Inc., is one of the most versatile of the CP/M cards I looked at. It not only performs its primary function very well, but it offers some unique features that benefit Apple DOS users as well. There are two models available—one with a Z80A (4 MHz) and the other with a Z80B (6 MHz). I reviewed a Z80B version with the 128Kb add-on RAM to supplement the 64Kb RAM resident on the main board. Also on-board is 2Kb of PROM that can be expanded to 8Kb PROM (although there is no further mention in the documentation as to how to utilize the additional PROM space).

There are two features that make this board a favored choice. First is its ability to display 70 columns with no extra hardware. The only hardware required is the standard shift-key modification—for this purpose, PCPI includes the plug, cable and clip that can be easily installed between the game port and encoder board. This may be a solution for you if the purchase of an additional 80-column card is impractical. Second, the 64Kb to 192Kb RAM on the card may be used as a RAM disk not only for CP/M but for DOS applications as well.

These two features create an excellent price/performance ratio for a user wanting either or both features for his Apple II. The software is provided on two disks, one containing CP/M 2.2 and the other utilities. The utility disk supplies ten useful tools. For example, the program ADOSXFER transfers files between Apple DOS 3.3 and CP/M. Binary, text, integer Basic and Applesoft Basic files may be transferred. This feature is valuable when capturing CompuServe data and then transforming it to run under WordStar.

In addition to supporting most 80-column cards, SoftVideo, also found on the utility disk, adds special characters and special functions not found on the standard 40-column Apple. Appli-Card supports the 31 control characters and all 96 of the printable ASCII characters. SoftVideo operates in two modes: one mode allows horizontal scrolling of the standard 40-column screen; the other utilizes the high-resolution mode to create the 70-column upper- and lowercase characters useful for word processing software such as WordStar.

The minimum 64Kb RAM on the Appli-Card allows you to run most CP/M programs without further memory considerations. Unfortunately, there is no ready possibility for running other languages, such as Microsoft Basic, on the card. However, the eight-inch disk version of Microsoft Basic will, when downloaded to a 5¼-inch disk, work properly. You may send the larger disk to PCPI for conversion or ask the dealer where you can buy the Microsoft Basic to perform the service. If you appreciate confirmation of your keystrokes, you may vary the volume of "click" given each time you depress a character. Or you can turn off the click entirely. The 6 MHz Z80B, while not as fast as some of the other cards, such as the Gold Card, is more than adequate for most tasks, except maybe for large sorts.

The Appli-Card package comes with two manuals. One, *CP/M Primer* by Murtha and Waite, is easy to read. It explains the mechanics and structure of the CP/M operating system. The other manual is a loose-leaf binder with information specific to the Appli-Card. It contains installation procedures, PCPI utility programs, SoftVideo use and some Appli-Card technical information. It is adequate at discussing these topics. However, if you are interested in an in-depth, technical treatise on CP/M 2.2, you'll want to take the manual's advice and consult further documentation from Digital Research publications. The operations manual recommends seven DRI publications in its bibliography.

The Appli-Card is the best card for the user who runs some CP/M applications but would also like to have some advantage when running DOS 3.3. The benefit of the RAM pseudodisk is a strong feature as is the DOS 3.3 CP/M file transfer utility. MicroPro calls the product StarCard and offers substantial discounts if you also purchase WordStar or one of the other Star products. The documentation from MicroPro is the same as what's available from PCPI under the Appli-Card name. Either way, Appli-Card easily holds its own.

CP/M Card

This card, made by Advanced Logic Systems (ALS), runs under CP/M 3.0. This card and the Gold Card are the only ones running CP/M 3.0. For users who prefer CP/M 3.0 and who don't need the built-in 80 columns and 192Kb RAM found on the Gold Card, this card is a sound choice. It runs with a Z80B CPU at 6 MHz. The card has a nonexpandable 64Kb of RAM that assures ample space for running most CP/M applications but precludes running banked CP/M for greater speed.

The card comes with three disks that contain CP/M 3.0, CBasic, utilities from Digital Research and utilities supplied by ALS. The box claims to include GSX-80, the logical extension to the operating system that provides

	DRI Gold	ALS CP/M	MS SoftCard	PCPI Appli-Card	ALS Z-Card II
CP/M	3.0	3.0	2.23	2.2	2.2
Basic	CBasic	CBasic	MBasic		
Processor	Z80B	Z80B	Z80A	Z80B	Z80B
	6 MHz	6 MHz	2 MHz	6 MHz	n/a
CP/M Clock	yes	yes	no	no	no
RAM	64/192	64	0	64/128K	0
Price	$495/$775	$399	$345	$495/$595	$169

Table 1. Apple CP/M comparison chart.

graphic input and output functions through standard calling procedures. However, my package didn't contain GSX-80. Instead, there was a form to fill out that said GSX-80 would be sent at a later date. Apparently, ALS has had delays getting GSX-80 from Digital Research. The documentation on GSX-80 was also missing from the package.

The ALS utilities simplify using the CP/M Card. APPMAKER, for example, completely prepares a working disk for an application program or file disk. It formats the destination disk. Then it places the utilities most often used with an application program on the disk. Hello, while not quite as convenient as an autoexec program, eliminates direct operator intervention with the operating system. It displays the default drive directory and, through menu selection, allows the user to run a program or commonly used utility, such as making a back-up disk.

One ALS utility that is no longer necessary is WSMAKER. For versions of WordStar 3.31 and above, this program will not work—use WordStar's own Install program. If you have an earlier version of WordStar without 3.31's new simplified install process, then this program is perfect for you. Unfortunately, the CP/M Card user's guide makes no mention of this. I tried and tried to install my WordStar 3.31 before calling ALS. The board supports most popular 80-column boards, particularly ALS's own Smarterm cards.

The CP/M card is more than enough for almost any application. Its 64Kb RAM ran well with WordStar, PerfectCalc and any other application I could find. The card was slow when large quantities of data were sorted or listed—this in spite of its 6 MHz clock. This card may not work with other peripheral cards—specifically, the Tymac parallel printer card may cause malfunctions. Beware, too, if you're using a CPS multifunction card. Depending on the configuration of the CPS card, the CP/M card may not boot properly. If you experience any erratic behavior, try changing the CP/M card slot. I mysteriously solved a problem by putting the CP/M card in slot 7 instead of slot 4.

The CP/M card comes with a single manual. Within the book is the CP/M card user's guide. It is a 40-page book that details the installation of the card. It also explains each of ALS's utility programs. However, an update notice practically rewrites the entire user's guide. By the time I made substitutions to the user's guide, I was thoroughly confused. Hopefully, ALS will reprint the user's guide with corrections in the near future. The other two sections of the manual are standard Digital Research documents—CP/M Plus user's guide and the CBasic reference manual. These two are excellent guides for the programmer of CP/M 3.0 or CBasic.

This card is the best card for the CP/M 3.0 or CBasic user who has an 80-column display or does not otherwise need the extra capability of the Gold Card. If an earlier version of CP/M is adequate for your purposes (such as running most CP/M applications), then this card may be more than you need. The 64Kb RAM, while not expandable, is sufficient for most tasks. While I found a few problems as mentioned above, all of my questions were quickly answered by ALS technicians who answer ALS's toll-free lines. Without knowing that I was reviewing their product, they were patient and thorough in their help.

Z-Card II

This card by Advanced Logic Systems (ALS) is really in a category of its own. It is a no-frills, low-cost way to add CP/M to your Apple. With the Z-Card II and an Apple Language Card, any CP/M application can be made to run on the Apple II. The major difference is that this card has no on-board memory. Also, the CP/M supplied is version 2.2 rather that 3.0. The version differences make little or no difference for most commercial CP/M application programs. The card has utilities similar to the CP/M Card above. APPMAKER and Hello make the card easy for the user not familiar (and not caring to be familiar) with CP/M. There's a help file that explains how to configure WordStar, SuperCalc and Condor Jr. to work with the Z-Card II. The WordStar installer, like the one for the CP/M card above, is for versions of Wordstar prior to 3.31. The CPU is the Z80B.

The program disk comes configured for a 44Kb RAM Apple II, which the card will access. A utility program labeled BIGSYS will patch the disk to take full advantage of a 64Kb equipped Apple. The documentation doesn't state which memory/language card will or won't work with the card. Mine is a somewhat offbeat card that the Z-Card wouldn't recognize. Every time I booted the system with BIGSYS installed, the system froze. It was impossible to install WordStar and run any sort of test with it. However, all of the other utilities and features worked flawlessly.

The Z-Card II is really in a category of its own—it's a no-frills, low-cost way to add CP/M to your Apple.

The only document that comes with the Z-Card II is the user's manual. It explains with some accuracy the installation and operation of the card. It explains each of the ALS utility programs. A document on the program disk entitled LATEST.DOC lists some modifications to the user's manual. There is also a sheet included entitled "Z-Card Software Revision Information." This sheet warns the user that some of the correction references in the LATEST.DOC to the user's guide aren't accurate. Confusing? Yes.

Details of operation for CP/M 2.2 can be obtained through publications of Digital Research or any number of CP/M books that are available.

The Z-Card II is the economical choice for the user who primarily wants to run applications software. The card offers no expansion ability. The Z-Card and a language card affords you use of the most popular CP/M applications programs.

The choice between cards is not an easy one. Nor is it possible to know the personality of any card by its wrapper or price. While the Apple II may be at a disadvantage by not having a Z80 resident, no other computer owner desiring CP/M operation has so many choices.■

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1195 E. Arques Ave.
Sunnyvale, CA 94086

Digital Research
PO Box 579
Pacific Grove, CA 93950

Microsoft
10700 Northup Way
Bellevue, WA 98004

Personal Computer Products, Inc.
16776 Bernardo Center Drive
San Diego, CA 92128

Cheap and Easy

If you're tired of digging deep into your pockets every time you invest in software, relief is here. Martin Moore reviews a few good, no-frills packages that won't send your bottom line soaring out of sight.

By Martin Moore

What is cheap? These days, when you hear the word "cheap," you tend to equate it with "shoddy workmanship." But cheap also means low-cost; cheap isn't always "cheap."

What I'd like to do in this article is talk about cheap software—in particular, about three low-priced software packages available for the Heath/Zenith H89 and Z89.

The software under discussion comes from a firm called The Software Toolworks. The folks at The Software Toolworks specialize in software that runs on Heath/Zenith machines (CP/M and HDOS), as well as providing Osborne and Kaypro software. I'll discuss the editor and text processor, as well as a data communications program.

Text Editing/Processing

When you look through the pages of *Microcomputing*, you see ads for a lot of word processing packages. The majority of them have price tags of more than $250. And they're usually worth it—if you really need that kind of power. Packages like WordStar are excellent pieces of software. They let you do almost anything you like to your text.

If, however, your word processing activities involve simple letters or an occasional article or report, you probably don't need to spend that kind of money.

A Nice Slice

Pie 1.5 (or Pie, for short) is a full-screen editor—meaning that it's an editor that shows you a screen full of text, not just the current line. At $29.95 you have to agree that it's cheap. But it has hundreds of dollars worth of capability. Let's look at Pie in detail.

The H89 normally displays 24 lines of text. A 25th line is available for messages or status lines. Pie uses all 25 lines. The top 24 are used to display the text you're working on. The 25th line is used for a number of other things.

On the right side of the 25th line, Pie keeps a running total of available memory. The editor also tells you what line of text your cursor is currently on.

Pie works in an overstrike mode unless you tell it otherwise. If you want to insert a word or letter, you press the keypad key IC (insert character). When you do, a message is displayed on the 25th line telling you you're in Insert mode. The 25th line is also used to display search strings and error messages.

Generally, Pie is a cursor-controlled screen editor. If you want to move the cursor, you press the appropriate keypad key to the right of the main keyboard. Push the up arrow and the cursor moves up on the screen. The down arrow moves the cursor down, and so forth. A delete character key removes the character above the cursor. The insert character key lets you insert text at the current cursor position. An insert line key inserts a blank line above the current cursor line, and the delete line key deletes the line that the cursor is on.

The H89's eight special function keys are used to good advantage by Pie. You can move through the text a screen at a time in either direction by pressing the appropriate function key. Function keys let you move to the top or the bottom of the file with one or two keypresses.

The H89 handles 80 characters on a line. Pie rings the terminal bell when the cursor moves past position 76, letting you know that you're about to reach the end of the line; it's much like a typewriter bell. The biggest feature that Pie lacks is automatic word-wrap. You have to hit the return key if you want to move on to the next line.

If you make an error while entering text, you have the option of backing over the error and reentering the text, or you can insert new characters by pressing the insert character key and putting the editor in Insert mode. One thing I like about this mode is that you can still do any of the other editor functions while in Insert. If you prefer, you can stay in Insert mode all the time.

If you want to move a line, or several lines (up to 24), it's fairly simple. Move the cursor to the first line you want moved and press the enter key on the keypad. You then enter the number of lines you'd like moved—from one to 24. Then you press the pick key. The editor saves the lines you specified in a temporary buffer without removing them from their current location. You then move the cursor to the point where you want to place the lines. Press the put key, and the picked lines are inserted in the text. You do have to go back and

delete them from their original location, however.

The editor lets you search for a string in front of or behind the cursor. Search strings can be approximately 40 characters long. Once you type the characters, you press the 0 key on the keypad to search forward in the file or the period key to search backward. The editor remembers the last thing you searched for, too. If you want to do another search in either direction, simply press the appropriate direction key.

Getting Around

There are a number of ways to move around in a file. As I mentioned before, you can move the cursor left, right, up or down with the keypad keys. You can also jump the cursor to the left or right side of a line by holding the shift key down while pressing the right arrow key. Typing shift-right arrow always moves the cursor to the right side of the line the first time you press it, and to the left side of the line the second time.

If you want to move to the top of the file, you press function key 3. If you want to move to the bottom of the file, you press enter followed by F3.

If you want to move the text displayed on the screen up or down a line at a time, and yet keep the cursor on the same line, Pie lets you do that, too. The F2 key moves the text up; F4 moves the text down.

Finally, you can move through the text a screen at a time in either direction by using function keys 1 and 5. (A simple paper template laid above the top row of keys helps you remember what each function key does.)

I've had the opportunity to use a number of editors in my day, and I've never seen one with a function quite like Pie's Do key. It can be thought of as a macro key. The Do key stores up to 25 lines of editor commands.

The process begins when you press the enter key and then the Do key. A message is then displayed on the 25th line that reads: "Recording initiated." That means that the Do key will remember everything you do until you tell it to stop. When you're done, press the Do key again. Pie responds, "Recording completed."

Once you've recorded a series of commands, Pie will execute them when you press the Do key. You can also tell Pie to execute the commands a specific number of times by pressing enter followed by a number and then by Do.

Pie 1.5 is a good, highly capable editor. It came to me bug-free, and I've had no complaints since I laid down my $29.95. If you need an editor, but don't need a Rolls Royce, take a look at Pie.

Text 4.0

The formatter associated with Pie is called Text 4.0. Text takes up about 63 disk sectors (16Kb of memory), and it does a lot of things. Like Pie, Text is available in both HDOS and CP/M formats and costs ten bucks more at $39.95.

Aside from text-handling capabilities, a formatter's most measurable attribute is its ease of use. Some formatters let you embed formatting commands in the text, while others require that each formatting command exists on a line by itself. Text falls into the latter category (what do you expect for $39.95?).

Formatting Features

Text lets you use running heads in a pretty reasonable manner. Each header line is divided into three fields: a left field, a center field and a right field. You can put whatever text you like in each field at the beginning of a file, and Text will reproduce that header at the top of each output page. Running footers are invoked in nearly the same manner as running heads are. Page numbers are also supported.

You can adjust the page size both horizontally and vertically with Text. There are four commands that deal with the number of lines on a page; four more commands work on left and right margins.

Adjustments to the left and right margins are handled very easily. The left margin is set by the .in command. The right margin is set by the .rm command. To temporarily change either margin, you can set them relative to the fixed margin by adding a plus or minus sign to the number in the command.

Text gives you control of your final output. You can set the number of lines on a page and you can force a page break. If you want to make sure that a table isn't going to be broken in the middle by a page break, you can tell Text to advance to the next page if a specified number of lines is not available on the current page.

You can ask Text to make both the right and left margins even (justified), or leave the right margin ragged. When Text is working in the fill mode, each line is filled with as many characters as possible without overrunning the right margin. You have the option of printing each line just as you type it by turning off the justification and fill options.

Text also lets you control indenting, including hanging indents and paragraph indents, with a few simple commands.

Text can create bold text by overprinting several times (you can set the number of times the text is overprinted). Underlines are no problem either. Finally, a single command will let you center either one line or all of your text.

Other Features

You can request that Text format an entire series of files simply by adding the filenames to the end of the first file. Text formats the first file, then reads and formats each of the remaining files until it's done.

You have as much latitude in printer control as your printer allows, because both Pie and Text pass over control sequences. You can embed as many printer control sequences in the file as you like.

One of the nicest things about Text is that it allows you to view your file on screen as it will be printed. Any text that you've specified as bold or underlined is highlighted in reverse video. Instead of formatting a file and sending the output to another file or to the printer, you can simply leave off a destination name and Text will send the formatted output directly to the H89 screen.

Text has quite a few other features that I like. For example, you can put terminal messages anywhere in the input file, and Text automatically routes them to the H89's screen instead of to the printer. This, along with the capability to pause printing at any time, lets you change print wheels, ribbon or paper whenever you want.

Another feature is that you can start printing a file at any page, not just at the beginning. When you enter the formatting command, just tell Text which page to start on.

Text is a highly versatile text formatter. Unlike some other text formatters, however, Text is a batch formatter; that is, Text doesn't format text as you enter it. You first enter text and store it in a file. Text will then format the file for you.

My experiences with Text 4.0 have been just like my experiences with Pie 1.5. Both have been trouble-free, and

have been well worth the $69.90 I paid for them.

Reach Out

Communications software packages are intended to turn your personal computer into a smart terminal so that you can talk to another computer. Reach does just that.

The Reach communications package turns the H89 into a smart terminal with file transfer capabilities. You can connect the H89 to a modem, run Reach and dial into an information service with ease. You can download files from the service onto your disk and you can send files from your disk to the service.

Reach is menu-driven and makes use of the special function keys on the H89 keyboard. When you load Reach, you see:

F1 = Printer On/Off
F2 = Spool to Disk
F3 = Spool from Disk
F4 = Display Options Menu
F5 = Display This Menu

The F1 option lets you print information on your printer as it comes in from the remote computer. The F2 and F3 options let you store data from the remote computer on a disk and send data from a disk file to the remote computer.

The F4 option selects yet another menu:

0: Change the Diskette in SY0:
1: Change the Diskette in SY1:
2: Change the Diskette in SY2:
3: Enter Normal Mode
4: Enter Literal Mode
5: Turn On Local Echoing of Typing
6: Turn Off Local Echoing of Typing
7: Hang Up on Modem and Exit
8: Exit without Hanging Up
9: Do Nothing; Continue Reach Operation
A: Abort Printer Operation

As you can see, selections 0 through 2 let you change the disks you've got mounted. Selections 3 and 4 have to do with the end-of-line terminators sent by the remote computer. For example, the HDOS operating system terminates each line with a linefeed character. The CP/M operating system terminates lines with a carriage return followed by a linefeed. Reach views both of these situations as normal. However, you might reach a computer that pads each line with multiple line feeds. If you have to be able to store those linefeed characters, the literal mode allows you to do so.

Items 5 and 6 turn on either full- or half-duplex operations, depending on what the host computer does. Items 7 and 8 let you either stop communications and go back to the operating system or maintain communications while you temporarily exit to the operating system. Items 9 and A are self-explanatory.

Reach can be configured for a variety of communications protocols and can be set to operate from 75 bits per second (bps) to 19,200 bps. Configurations are accomplished by patching the Reach source code.

Reach is a reliable, flexible communications software package. Although you can't set communications protocol and bit rate very easily, the package costs only $19.95, and that makes it hard to beat.■

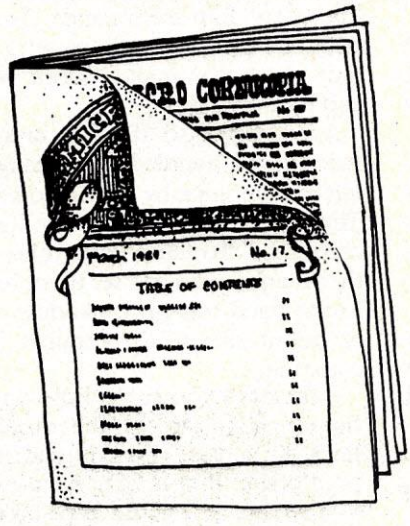
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DM 5112CX
SANYO
MBC-550
POWER
ESC
PF6
PF1
PF7
PF2
PF8
PF3
PF9
PF4
PF10
PF5
CTRL
SHIFT
LOCK

The Sanyo MBC-550

How Much Is That Micro?

At $999, the Sanyo MBC-550 is the clear-cut winner in the least-expensive-MS DOS computer contest. The modestly priced micro comes with 128Kb and one single-sided disk drive. The system's bundled software includes WordStar, EasyWriter I and CalcStar.

By Terry Kepner

Finally, someone has designed an MS DOS home computer that looks as if it belongs in a home. The new Sanyo MBC-550 (and MBC-555), with its stylish, thin, sleek, polished chrome appearance blends in perfectly with the average home component stereo system.

If you happen to like the new component TV systems, with their quality TV monitors, stereo video receivers, separate speakers and compatibility with normal stereo components, you'll love the new Sanyo computer and the way it disappears among the other components. When you want to use it, just turn it on (make sure it's plugged into the monitor), pull the separate keyboard out of hiding and begin working.

And if you don't want to "hide" the unit among your stereo components, its attractive design complements most office or modern room decors.

If appearances were the only criteria, then the Sanyo computer would rate a good hard look from an MS DOS buyer. But there's more to it than that. Not only is it stylish, it comes with bundled software that easily doubles the value of the computer, without doubling the cost. In fact, the Sanyo is, without a doubt, the least expensive MS DOS computer on the market, coming in at $999 (that's without the monitor, and you can't just use a color TV).

What you get for your $999 is a 128Kb MS DOS computer with one double-density, single-sided disk drive, MS DOS 1.0, and WordStar, EasyWriter I and CalcStar as the bundled software.

If you want a dual-drive unit, you can order the MBC-555 ($1399), or just order the second drive ($399) for your MBX-550 and have it installed by a dealer. You can also do it yourself (instructions are provided in the manual).

In either case, the second drive includes more bundled software, with your choice of SpellStar, Mailmerge (for WordStar) and InfoStar, or an IUS software package consisting of EasyWriter II, EasyPlanner, EasyCalc and EasySpeller.

A Popular Chip

The Sanyo MBC-550 is based on the popular 8088 CPU and runs at 3.6 MHz. It comes standard with 128Kb of RAM (upgradeable to 256Kb) and 48Kb of video RAM (16Kb is in user RAM). An 8Kb ROM contains the initial power-up logic (IPL) and color graphics logic.

If you're using a color monitor, the display parameters are as follows: eight colors (including black and white), 640×200 eight-color resolution, a 6×7 character font in an 8×8 dot box with 80 characters per line and 25 lines per page. The monochrome parameters are similar, except that you don't have colors available.

The floppy disk drives, which consist of 160Kb double-density units, are a disappointment. The limited disk space is a problem when using the bundled software; since you must put MailMerge on the same disk as WordStar, you rapidly begin to run out of room. Fortunately, though, double-sided (320Kb) drives will be available around June, as will hard disks ($1995) and DOS 2.0.

For the adventurous, TEAC 55B drives ($169 in quantities of two) are compatible and fit in the MBC-550 cabinet. It's possible that these will be the drives used by Sanyo when they offer upgrades (since the current drives are also TEAC). If you decide to install your own double-sided drives, a compatible BIOS is available from Michtron in Michigan at $49.95. The drives are available from ANI (17752 Sky Part Circle, Irvine, CA 92714).

The standard drives can't read IBM double-sided disks, but single-sided disks can be read.

The review unit is a single-drive 128Kb machine with a standard black-and-white monitor and a second uninstalled disk drive.

The installation instructions for the second drive, included in the main manual, were insufficient for a novice, but the second drive is supposed to be installed by the dealer anyway. The manual clearly states that inexperienced users shouldn't install the second drive.

The primary problem is the omission of instructions on removing the large plastic case that's in the second drive's position on a single-drive computer. It must be removed for the second drive to fit. With these instructions in hand, the second drive installation is fairly simple.

Helpful Hardware Hints

Calling the Sanyo area representative for drive installation instructions elicited these additional helpful hardware hints on getting the most from the machine. First, remove the cover and disconnect the wires leading to the internal speaker, cover them with tape and tuck them out of the way.





Second, if you're using a black-and-white monitor, find the DIP switch bank on the back of the computer and set #1 to On and the rest to Off.

The first hint eliminates the annoying beep used to denote syntax errors and the second configures the MBC-550 from color to monochrome operation, doubling the display resolution.

The keyboard is attractive, well-designed and well-made, with 81 keys, including function keys and a numeric keypad, and a coiled keyboard connector cable that gives you positional flexibility.

The keys don't click as you type, and the shift lock and graph lock keys have LED indicators so you know when they've been activated. The keyboard can generate 223 different characters, including the standard ASCII characters, by using combinations of the graph, shift and control keys. The computer can actually display 255 characters, with the extra 32 characters occupying the first 32 ASCII positions, which the keyboard uses to generate control codes instead of character codes. (To print these characters you must use CHR$(x), or its equivalent). See Fig. 1 for the entire Sanyo character set.

There are five function keys on the keyboard, with both shifted and unshifted values, for a total of ten functions. This can be a problem since the insert and delete functions are both assigned to the same key. This leads to problems if you're a sloppy typist like I am.

The numeric pad uses the standard layout, with both 0 and 00 keys like a good calculator, and also doubles as the cursor-control pad: left, right, up, down and home (which puts the cursor in the upper left corner of display).

Physically, the keys are sculptured with a gradual curve to assist in typing. The whole keyboard gently slopes towards you.

The keyboard is an improvement

Character Set (00-7F)

DECIMAL VALUE	➡	0	16	32	48	64	80	96	112
⬇	HEXA DECIMAL VALUE	0	1	2	3	4	5	6	7
0	0	BLANK (NULL)	►	BLANK (SPACE)	0	@	P	‘	p
1	1	☺	◄	!	1	A	Q	a	q
2	2	☻	↕	"	2	B	R	b	r
3	3	♥	‼	#	3	C	S	c	s
4	4	♦	¶	$	4	D	T	d	t
5	5	♣	§	%	5	E	U	e	u
6	6	♠	▬	&	6	F	V	f	v
7	7	•	↨	´	7	G	W	g	w
8	8	◘	↑	(	8	H	X	h	x
9	9	○	↓	)	9	I	Y	i	y
10	A	◙	→	*	:	J	Z	j	z
11	B	♂	←	+	;	K	[	k	{
12	C	♀	∟	,	<	L	\	l	¦
13	D	♪	↔	–	=	M	]	m	}
14	E	♫	▲	.	>	N	^	n	~
15	F	☼	▼	/	?	O	_	o	△

Character Set (80-FF)

DECIMAL VALUE	➡	128	144	160	176	192	208	224	240
⬇	HEXA DECIMAL VALUE	8	9	A	B	C	D	E	F
0	0	Ç	É	á	1/4 Dots On			∝	≡
1	1	ü	Æ	í	1/2 Dots On			β	±
2	2	é	FE	ó	3/4 Dots On			γ	≥
3	3	â	ô	ú				π	≤
4	4	ä	ö	ñ				Σ	⌠
5	5	à	ò	Ñ				σ	⌡
6	6	å	û	a				μ	÷
7	7	ç	ù	o				τ	≈
8	8	ê	ÿ	¿				Φ	°
9	9	ë	Ö	⌐				⊖	•
10	A	è	Ü	¬				Ω	•
11	B	ï	¢	1/2			■	δ	√
12	C	î	£	1/4			■	∞	η
13	D	ì	¥	i			■	∅	2
14	E	Ä	Pts	«			■	∈	▮
15	F	Å	f	»			■	∩	BLANK FF

Fig. 1. The entire Sanyo character set.

over the IBM keyboard, but then again almost anything would be an improvement over the IBM. Fig. 2 shows the translation table for the two computer keyboards.

In operation, the computer performs well, but it does have one idiosyncrasy: the disk drive light is always on. On most computers, the LED disk drive light is used to signify that the drive is currently reading or writing to the disk; however, on the Sanyo, the light is used to tell you which disk drive is logged in as the current MS DOS drive.

On a two-drive system this might be useful, but on a single-drive system it's a waste. It can also be confusing. Since you never know when the computer has finished writing to a disk, you don't know when it's safe to remove it from the disk drive.

The typing action is fast and clean, but if you make a mistake, the computer lets you know about it with a loud, obnoxious, low-pitched "burp"—almost like a bronx cheer. This is annoying and elicited numerous complaints from my wife when I stayed up late using the machine.

Suitable Software

As I mentioned earlier, the single-drive computer is sold with EasyWriter I (a word processor for beginners and intermediate users), WordStar (the number 1 selling word processor on the market) and CalcStar (a spreadsheet manipulation program).

These three packages cover most of the uses MS DOS computers are called upon to service.

Adding the second drive, with SpellStar (spelling checker for WordStar), MailMerge (for mass-mailing wordstar documents) and InfoStar (a database manager), completes the package.

All the "-Star" packages are IBM PC compatible, with only minor alterations in operation. WordStar, for example, is slightly off-color when used on a standard IBM PC with color graphics board and monitor.

If, however, you decide to use the IUS software, you can use them only with the Sanyo MBC-550 and -555 computers, since IUS has decided to customize the bundled software to work only on those computers.

MS DOS and GWBasic programs will work on the Sanyo MBC-550, with the exception of programs that make specific calls to IBM hardware or use nontransportable color and graphics commands. This is the same *caveat emptor* that all MS DOS-compatible computer owners must skirt. Any program that requires specific hardware designs found only in the IBM won't work in the PC-compatible computer. Programs that use only the standard MS DOS machine code call locations should work just fine in the MS DOS environment.

The Basic Decision

The Basic isn't as easy a decision. It isn't a Microsoft Basic. To take full advantage of the machine's capabilities, Sanyo decided to write its own Basic. This Basic is definitely superior to Microsoft's if only for one reason: it's not limited to only 64Kb of RAM.

IBM	Sanyo
ALT	CTRL + SHIFT
CTL + PF1	CTRL + =
CTL + PF2	CTRL + SHIFT LEFT BRAC
CTL + PF3	CTRL + SHIFT RIGHT BRA
CTL + PF4	CTRL + SHIFT :
CTL + PF5	CTRL + SHIFT "
CTL + PF6	CTRL + SHIFT ;
CTL + PF7	CTRL + SHIFT '
CTL + PF8	CTRL + SHIFT ,
CTL + PF9	CTRL + SHIFT .
CTL + PF10	CTRL + SHIFT /
ATL + PF1	CTRL + PF1
ATL + PF2	CTRL + PF2
ATL + PF3	CTRL + PF3
ATL + PF4	CTRL + PF4
ATL + PF5	CTRL + PF5
ATL + PF6	CTRL + SHIFT PF1
ATL + PF7	CTRL + SHIFT PF2
ATL + PF8	CTRL + SHIFT PF3
ATL + PF9	CTRL + SHIFT PF4
ATL + PF10	CTRL + SHIFT PF5
SHIFT + PF1	CTRL + 1
SHIFT + PF2	CTRL + 2
SHIFT + PF3	CTRL + 3
SHIFT + PF4	CTRL + 4
SHIFT + PF5	CTRL + 5
SHIFT + PF6	CTRL + 6
SHIFT + PF7	CTRL + 7
SHIFT + PF8	CTRL + 8
SHIFT + PF9	CTRL + 9
SHIFT + PF10	CTRL + 0
CTRL + 2	CTRL + BACK ACCENT
CTRL + 6	CTRL + SHIFT TILDA

Fig. 2. A translation table for IBM and Sanyo keyboards.

Microsoft Basic is artificially limited to 64Kb; no matter how much RAM your computer has, 128Kb or one megabyte, Microsoft Basic uses only 64Kb of the RAM. The rest is ignored. This severely limits programs by cutting them off from the RAM available in your computer.

Sanyo Basic, though, provides complete access to all the RAM installed in your computer, giving you the option of using Basic programs with large databases or arrays in memory.

Several immediate possibilities are in-memory mailing lists or specialized data files. The disadvantage is that not all Basic programs for IBM Basic will work in Sanyo Basic.

The other differences in the Basics are operational and in the selection of keywords (See Fig. 3 for a list of Sanyo keywords and the IBM keywords not included in Sanyo Basic).

On-screen editing is one of the operational differences that Sanyo didn't improve upon. It's not as good as Microsoft Basic; for example, you can't change line numbers on screen (like 10 PRINT to 20 PRINT); you can't edit command lines (like changing RUN 100 to RUN 200); you must press the break key when the editing is finished, and after editing the cursor returns to its previous position. Although you can insert a line, you don't have an insert mode. To add a command or text to a line, you must first insert spaces in the line and then type the addition over the spaces.

An annoying feature of this Basic is that when you press the break key to terminate the editing, the computer's built-in speaker burps at you. The only way to handle this is to disconnect the speaker, as I already mentioned.

To assist the Basic programmer, Sanyo Basic lets you use two- or three-keystroke shorthand for entering Basic commands; for example, CTRL and "A" prints the Basic command AUTO on the screen; CTRL and "G" prints GOTO. You can enter 39 different keywords using this shorthand method.

Sanyo Basic introduces one graphics command that I wish Microsoft had for its Basic: Symbol. This command lets you print a character or set of characters on the screen in one of seven sizes of height and width and rotate it in four positions (90-degree increments)! You can print it tall and skinny, short and fat, upside down, sideways and in many other ways.

Another improvement over the IBM

Sanyo keywords					
ABS	CVI	GET	LOG	PRESET	STR$
ALL	CVS	GO	LPOS	PSET	STRING$
AND	DATA	GOSUB	LPRINT	PRINT	SUB
AS	DATE$	GOTO	LSET	PUT	SWAP
ASC	DEF	HEX$	MERGE	RANDOMIZE	SYMBOL
ATN	DEFDBL	IF	MID$	READ	SYSTEM
AUTO	DEFINT	IMP	MKD$	REM	TAB
BASE	DEFSNG	INIT	MKI$	RENUM	TAN
BEEP	DEFSTR	INKEY$	MKS$	RESET	THEN
CALL	DELETE	INP	MOD	RESTORE	TIME$
CDBL	DIM	INPUT	NAME	RESUME	TINPUT
CHAIN	ELSE	INPUT$	NEW	RETURN	TO
CHR$	END	INSTR	NEXT	RIGHT$	TROFF
CINT	EOF	INT	NOT	RND	TRON
CIRCLE	EQV	KEY	OCT$	RSET	UNPACK$
CLEAR	ERASE	KILL	OFF	RUN	USING
CLOSE	ERL	LEFT$	ON	SAVE	USR
CLS	ERR	LEN	OPEN	SCREEN	VAL
COLOR	ERROR	LET	OPTION	SEG	VARPTR
COM	EXP	LFILES	OR	SET	VIEW
COMMON	FIELD	LINE	OUT	SGN	WAIT
CONT	FILES	LIST	PACK$	SIN	WEND
COS	FIX	LLIST	PAINT	SPACE$	WHILE
CSNG	FN	LOAD	PEEK	SPC	WIDTH
CSRLIN	FOR	LOC	POINT	SQR	WINDOW
CVD	FRE	LOCATE	POKE	STEP	WRITE
	GCURSOR	LOF	POS	STOP	XOR

IBM reserved words not in Sanyo Basic

BLOAD
BSAVE
DRAW
EDIT
ENVIRON
ENVIRON$
ERDEV
ERDEV$
MKDIR
MOTOR
INTER$
IOCTL
IOCTL$
PLAY
PEN
PMAP
RMDIR
SOUND
STICK
STRIG
TIMER
VARPTR$ (SANYO uses VARPTR)
WRITE$

Fig. 3. A list of Sanyo keywords and IBM keywords not included in Sanyo Basic.

Sanyo "new" error codes		
FILE WRITE PROTECTED	PRINTER NOT READY	DIRECT STATEMENT IN FILE
BAD DISK SELECT	**IBM error codes not on Sanyo computer**	DEVICE UNAVAILABLE
BAD FILE DATA	STRING FORMULA TOO COMPLEX	COMMUNIATION BUFFER OVERFLOW
PORT I/O ERROR	MISSING OPERAND	DISK WRITE PROTECTED
OUT OF ARRAY SPACE	DEVICE TIMEOUT	DISK MEDIA ARE
PRINT FIELD OVERFLOW	DEVICE FAULT	ADVANCED FEATURE
POSITION NOT ON	OUT OF PAPER	PATH/FILE ACCESS ERROR
	INTERNAL ERROR	PATH NOT FOUND

Fig. 4. A list of Basic messages found in the Sanyo and not found on the IBM; and the IBM messages not found on the Sanyo.

is that you can easily halt a program listing by pressing the space bar. Pressing any other key continues the listing.

Finally, Sanyo Basic has 146 different error messages, as opposed to IBM's 53. Fig. 4 lists the new messages not found on the IBM and also lists IBM messages not found on the Sanyo.

When MS DOS 2.0 is released, some of the error messages left out of the Sanyo list may be included, which will increase the Sanyo's total count.

Better than the Average Manual

The system manual supplied with the Sanyo computer is much better than most; it describes all subjects completely and accurately, with examples and clear explanations.

The manual combines the instructions for Basic, MS DOS and the computer itself. The set-up section includes check-off boxes and diagrams so you won't lose your place while hooking up your printer or video. Even though these are simple procedures, the manual tries to make them foolproof.

In evaluating this computer, I talked

to a nontechnical Sanyo user. He had never used a computer before and found the manual to be sufficient and easy to understand. The commands are explained nearly to the point of being a tutorial.

The only complaint is that the manual fails to include instructions on how to work around the limited-capacity disk drives. He spent a lot of time figuring out that in order to use WordStar and MailMerge, he had to put them both on the same disk; this wasn't mentioned in the documentation.

The manuals were printed by a daisy-wheel printer (not typeset) with some areas shaded later as needed. It was written in-house by Sanyo staff and is an improvement over the manuals distributed by Microsoft. Documentation includes a complete and clearly written glossary and index.

The book, to our surprise, includes a section on technical information, describing the memory map, ROM map, interrupt vectors, I/O controller, some of the interrupt routines, I/O map and other programming information—a nice change from the "top secret" mentality that many companies seem to adopt.

The section on Basic is organized alphabetically by type (graphics commands all together, math commands all together and so on), rather than just alphabetically, but the index helps overcome that referencing limitation.

At the back of the manual is a section on installing peripherals like the second disk drive, RS-232C board and memory expansion. That's what I call helping the home user!

The other manuals included with the computer cover the bundled software, with one manual for EasyWriter I, WordStar and CalcStar, and the other manual for the software bundled with the second disk drive.

A Hot Item

The Sanyo computer is a terrific machine for its price and capabilities. The inherent limitations of single-sided drives will be corrected by the soon-to-be-available double-sided and hard disk drives.

The software delivered with the computer is a good way to computerize an office, step-by-step, including both a simple word processor and the most popular word processor, and a spreadsheet program.

By the time most users need to expand the system, the appropriate hardware and software will be available. The only disadvantage is the incompatibility of Microsoft MS DOS Basic and Sanyo MS DOS Basic.

Sanyo sells the MBC-550 primarily as a word processing/information management system. Considering the bundled software and low price, the machine fits the bill and is, indeed, a hot item. ■

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Program	Vendor	
Inventory Control	IUS	
Order Entry	IUS	
General Ledger	IUS	
Accounts Receivable	IUS	
Accounts Payable	IUS	
Easyspeller	IUS	
dBaseII	Ashton-Tate	
Bottom Line Strategist	Ashton-Tate	
Financial Planner	Ashton-Tate	
Perfect Filer	Perfect Software	
Perfect Calc	Perfect Software	
ATI Power of WordStar	American Training Institute	
Word Processor	The Benchmark	
Spelling Checker	The Benchmark	
MailList	The Benchmark	
Telecom	The Benchmark	
MemoPlan	Chang Labs	
Calendar	Hayden Software	
Pie Speller	Hayden Software	
Volkswriter	Lifetree	
System Manager	Business Management Systems	
Probase	Fugen International	
SSI legal	Satellite Software	
MU-Accountant	Intelacamp	
Type Faces	Alpha Software	
Power	Compute	
Personal Pearl	Relational Systems	(needs 320Kb drives)
Friday!	Ashton-Tate	
Wordperfect	Satellite Software	

Table 1. A list of IBM software that will run on the Sanyo MBC-550. The IUS software bundled with the Sanyo will run on that machine only.

The following is the transcript of a conversation with Arthur Shebar, the director of marketing at Sanyo:

MC: When you told your designers to give you a machine, what was their assignment?

AS: It's not quite that simple. The machine was conceived in Japan as an entry-level machine. The design criteria was a disk drive, 8088-based machine to come for under $1000 that had to meet the Sanyo quality—the commitment that we have to quality.

When it was conceived, it wasn't conceived as an MS DOS machine. The first machine is still being sold in Japan, as a CP/M-86 machine.

MC: It's doing well in Japan?

AS: Oh yes. It's quite different in Japan. It's a CP/M-86 machine, but it will run on composite color, using lower-grade graphics and using a 40-character by

16-line screen. We elected to make this what we consider to be a usable computer. Once we elected to bundle WordStar, CalcStar and EasyWriter I with it, we couldn't use lower-grade resolution graphics: it had to be hi-res monitors; it had to be 80 × 25 lines; and in color that means an RGB hi-res monitor.

MC: I've found that the Sanyo programs, or at least many of the ones you bundle with the computer, work fine on the other computers.

AS: Oh sure, we leave that up to the software vendor. Right now, when you buy our single-drive machine, you get WordStar, CalcStar and EasyWriter I. If you buy the second drive, or if you buy a two-drive machine, you get SpellStar, MailMerge and InfoStar. We leave it up to the vendors as to how machine-specific they want to make their software.

In the future, you'll have the option of either SpellStar, MailMerge and InfoStar, or EasyWriter II, EasyFiler, EasyPlanner and EasyMailer.

IUS Software has machine-specific programs to increase speed ...IUS is concerned that we're selling a second drive for $399 and bundling with it the EasyWriter package—that's $1200 worth of software, list price. IUS is concerned that somebody who has a Sanyo-compatible computer will buy our 160Kb drive for $399 and throw it away just to pick up the $1200 worth of software. So the software is file compatible, but it isn't program compatible.

MC: I've talked with a number of business users of the Sanyo and the worst complaint I've heard is about the limited disk drive.

AS: Yes.

MC: Do you plan to do anything about it?

AS: Absolutely. When it was apparent that we weren't going to have our own hard disks for a while, I requested Thoughtworks (Phoenix, AZ) to make a hard disk and gave them a set of schematics. They quickly came up with a hard disk interface that's working nicely, and they're doing well with it.

There are three or four other hard disk manufacturers who have their own hard disks with interfaces for our machine. We'll be introducing 320Kb drives shortly, and with the standard 320Kb drives, we'll be introducing our version of GWBasic. We'll also be introducing DOS 2.1 and our own hard disk. A hard disk is available for our eight-bit machines, but that doesn't mean that we won't continue to discuss and support the other guys.

MC: I've noticed yours is the only manual I've seen that comes with a set of schematics in the back.

AS: We are in the midst of publishing a detailed technical manual. It will be available to people who really want to do extensive development work on the machine or who want to dupe their own chip replacement or whatever.

MC: When do you expect the drives to be available?

AS: We asked the factory for the end of March, but their answer was June. However, they thought they might be able to move it up.

MC: Do you already have a pricing structure?

AS: Yes, it all depends on the drives. We have a tentative price...right now it looks like $200 per drive, but that isn't firm.

MC: Do you mind if I ask who makes them?

AS: That's what isn't firm. I don't know yet.

MC: I see.

AS: They're already getting 160Kb.

MC: Uh huh, you'll just be doubling that.

AS: Right.

MC: The documentation is superb in some areas, far better than my favorite, the Tandy Level I manual. In some areas users felt a little left out...especially in figuring out how to run WordStar and MailMerge at the same time. Do you plan updates?

AS: Yes, we do. There is always room for change and there are some minor errors in the manual that are being corrected in upgrades. It's an ongoing effort that absorbs an incredible amount of time. It's necessary.

MC: I noticed some differences in the Basic. The biggest one was the Symbol command, which I haven't seen before. Are there other major differences that you'd like to point out?

AS: We use binary coded decimal format, so we don't get the rounding errors that GWBasic gets when dealing with large numbers. The advantage we see to Sanyo Basic is that it will read and write Datasoft files; it doesn't have the 64Kb limitation that GWBasic has and it goes up to the edge of memory. Our Basic gives you greater flexibility. We're getting a lot of interest in our Basic from the educational community. You'll find it's pretty standard, with some changes. The other thing we did in our Basic was to identify the hardware. Everything's built in with simple commands.

MC: Who did that, by the way? Microsoft?

AS: No, that was done by Tokyo Sanyo, the factory. We have some very talented software engineering people.

MC: It's no surprise that it's such a fine machine.

AS: Oh yeah, we get an absolute consistency of product that isn't, I don't think, equaled anywhere in the country. Our policy—what we say to the dealer—is that if there is anything wrong with the machine we want to see that machine back. We talk about out of the carton reliability, and that's really our new advertising campaign, which should start in May. The reason why we are keeping relatively low-key and not really starting advertising campaigns is because we are sold out through April (ed's note: this interview was given on March 1, 1984). Even though our production forecasts were enthusiastic, the response was overwhelming.

MC: A number one rating in Auerbach's index certainly didn't hurt you.

AS: Oh, yeah.

MC: What's in the future for software?

AS: We've spoken to most of the major vendors. When we come out with GWBasic, we expect that a lot more software will be available. We

currently have a lot of software that's running. We maintain a very close relationship with IUS and with ADS Software, which is entry-level software. IUS Software is very sophisticated, so we have covered the business application portion of this product.

We're revising our list on a daily basis. We're loaning a machine to manufacturers on a 30-day basis. We're not that different from an IBM...normally it is a relatively easy port. We have twice as many colors and twice as many pixels, so some of the graphics stuff takes time. We are talking to Lotus and we're talking to a number of other people, so there will be programs available to cover everything. Microsoft just called us and told us Multiplan works.

Between all of the software packages that you can obtain free with the machine, we think we covered probably 40 or 50 percent of the market. Spreadsheet, simple database and -Calc programs are up and running on the machine, and they come free.

MC: Are there any other software packages, besides Multiplan, you'd like to mention?

AS: We have found everybody wants to buy games. We have seven or eight games that are running. I really can't think of anything offhand, except that dBase runs off the shelf. dBase Friday!, the financial planner, runs off the shelf.

When we talk about a high level of compatibility, we're talking about things that don't do direct memory accesses, that don't do graphics. In terms of direct memory access, unfortunately, our memory is in a different location.

MC: Besides graphics and direct memory access, there aren't any differences?

AS: No, it's an MS DOS, 8080 machine.

MC: Is there anything else you'd like to tell us?

AS: The only thing I'd like to add is that the same documentation group is currently working on video training. We're in the midst of taking what we've learned about training people and developing a video cassette application. As a matter of fact, we've already developed the front-end of this; it's going to start by saying, "You have the right to reproduce this, you have the right to give it away, to sell it, to do anything you want."

MC: That's a new message.

AS: Also, we'll say, "Sanyo wishes to announce to everybody that we will prosecute to the full extent of the law anybody caught not disseminating computer knowledge."

MC: I love it!

AS: I don't know if my lawyers will let me get away with it, but that's what we want to do.

MC: Great! Well, it's been a pleasure talking with you. Good luck with your machine.

AS: Thanks.□

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IBM, TI— Get the Connection

The author had an IBM PC at work and a Texas Instruments 99/4A at home. Naturally, he wanted to transfer files from the smaller 99/4A to the faster PC. This article describes the hardware and software modifications needed to make the IBM-TI connection.

By Kenneth Burchett

With today's vast computer market, it's not unusual for someone to have one kind of computer at home and a different one at work. Having a TI 99/4A of my own and an IBM PC at work soon made me want to adapt programs from the smaller unit to the faster machine. Texas Instrument's decision to drop the TI 99/4A and IBM's announcement of the PCjr was an added incentive to find a simple file-transfer method for these two popular brands.

Making the Connection

First, you have to connect the asynchronous communications support adapter on the IBM PC to the RS-232C interface card on the TI 99/4A. You can use a direct cable or a telephone coupler (modem). If you use a cable, you can buy one or make one from bell wire and two DB-25 connectors—one male and one female.

The required pin connections are shown in Fig. 1. Note that pins 4 and 5 on the IBM PC side are wired together to automatically turn on the clear-to-send input line. This cable hookup successfully moves files from TI 99/4A cassette storage to IBM PC disks and works equally well in disk-to-disk transfers.

The file transfer process is easier when you use the communications program in Listing 1. Prepare a disk containing DOS, BasicA, PCTICOM and the following AUTOEXEC.BAT file: BasicA PCTICOM.BAS/C:16000. A 16Kb buffer for receiving data is set aside to eliminate any possibility of a communication buffer overflow. The size allocated may vary with the system; however, it needn't be larger than the memory of the TI 99/4A to do the job. The maximum allowable is 32767 bytes.

One final note—some Basic program lines may be divided in the process of being translated, resulting in a Direct Statement in File error message when you try to run them. Therefore, it's useful to include a copy of the EDLIN editor provided with MS DOS on the utility disk. I find that, with just a few changes, most programs written on the TI 99/4A can be converted to

```
100 CLS:LOCATE 4,12
110 PRINT "=========================PCTICOM=========================="
120 LOCATE 5,12:L=1
130 PRINT "Program to transmit text files from a TI99/4A to an IBM-PC."
140 PRINT TAB(12) "File to be transferred must be in TI99/4A memory."
150 LOCATE 7,12
160 PRINT "Use CTRL BREAK to interrupt PC processor, CONT to continue."
170 PRINT TAB(12) "Use direct GOTO 100 to start over after CTRL BREAK."
180 'By K. Burchett, January 1983.  Ref: J.G. Schmidt, Microcomputing,
190 'November 1983; IBM Basic Manual, 1982; TI RS232 Reference, 1982
200 KEY OFF:CLOSE:LOCATE 9,12:ON ERROR GOTO 500
210 PRINT "============================================================"
220 LOCATE 12,28:PRINT "     1.  Transfer File"
230 LOCATE 14,28:PRINT "     2.  Return to BASIC(A)"
240 LOCATE 16,28:PRINT "     3.  Return to DOS"
250 LOCATE 19,14:INPUT "   Enter choice: ";C
260 LOCATE 20,1:CLS:ON C GOTO 280,540,560:GOTO 100
270 '
280 '     ======================Process File=======================
290 INPUT "Print transferred file on the screen (y or n)";P$:PRINT
300 INPUT "Print transferred file on a printer (y or n)";H$:PRINT
310 IF H$<>"y" AND H$<>"Y" THEN 340
320 INPUT "Number of lines per page (continuous=0)";L:P=1:PRINT
330 INPUT "Number of characters wide (maximum=255, TI=28)";WI:PRINT
340 INPUT "Save transferred file on diskette (y or n)";S$:PRINT
350 IF S$<>"y" AND S$<>"Y" THEN 380
360 PRINT "Enter filename for file to be received.  Add .BAS suffix if"
370 INPUT "file is BASIC program: ";FILE$:OPEN FILE$ FOR OUTPUT AS #2
380 WIDTH "lpt1:",WI: OPEN "COM1:300,O,7,,CS,DS,RS" AS #1:CLS
390 IF P=1 THEN PRINT "Ready Printer"
400 PRINT "Enter LIST RS232/1(in quotes) at TI99/4A.":PRINT
410 LINE INPUT #1,A$: IF LEFT$(A$,1)=CHR$(10) THEN A$=MID$(A$,2)
420 IF P$="y" OR P$="Y" THEN PRINT A$
430 IF P=1 THEN 440 ELSE 460
440 LPRINT A$:CTRH=CTRH+INT((LEN(A$)/WI))+1:IF CTRH<L OR L=0 THEN 460
450 PRINT:INPUT "Page change. Press ENTER to continue.";K$:CTRH=0
460 IF S$="y" OR S$="Y" THEN PRINT #2,A$
470 FOR T=1 TO 3000:IF LOC(1)>1 THEN 410
480 NEXT T:PRINT:PRINT:PRINT "*****Transfer Completed*****"
490 CLOSE:FOR I=1 TO 5000: NEXT I:CTRH=0:CLS:GOTO 100
500 IF ERR=69 THEN PRINT "**Overflow**":RESUME
510 IF ERR=25 OR ERR=27 THEN 520 ELSE 530
520 INPUT "Device Error. Check Printer. ENTER to continue.";K$:RESUME
530 ON ERROR GOTO 0
540 CLS:PRINT "End of session.  BASIC(A) resumed.":WIDTH "lpt1:",255
550 END:' ============================================================
560 SYSTEM
```

Listing 1. PCTICOM file transfer program.

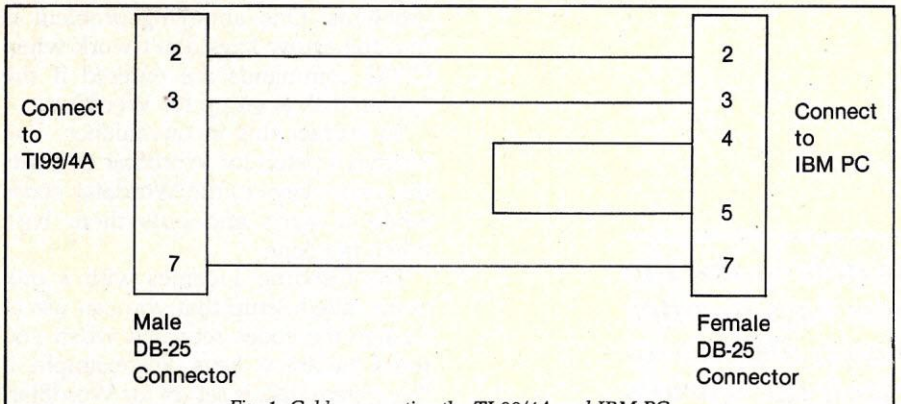


Fig. 1. Cable connecting the TI 99/4A and IBM PC.

run on the IBM PC. In order to be transferable, files must be ASCII text files. Default storage for TI files is Display (the equivalent of ASCII code).

The PCTICOM program has all the necessary features of the asynchronous communications support program (ACSP) to control data transmission, with the added convenience of being able to control the print setup, and without the comparatively long initialization time required by the ACSP. By configuring the IBM PC to the communication defaults of the TI 99/4A and using the TI's simple List "RS232" command, you can accomplish the whole transfer process very quickly.■

Address correspondence to Kenneth E. Burchett, SR 2, Box 4040, Branson, MO 65616.

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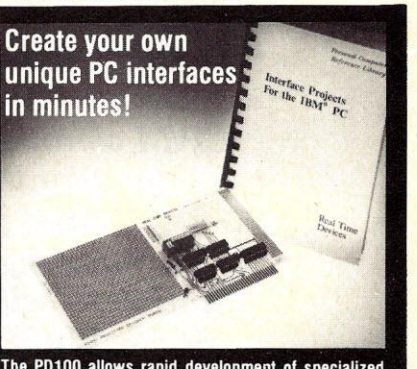
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WordStar, CP/M, Osborne And You

By Tim Norton

Okay, not being able to use the Osborne 1's arrow keys to enter CP/M commands on a disk set up for WordStar isn't the world's worst problem, but it is an annoying inconvenience. The author, a self-proclaimed hacker, decided he'd rather write a short program than put up with even a small inconvenience.

The Osborne 1 is a very well-designed and flexible system, but like everything else, it has its little problems. One annoying problem is that the arrow keys don't work when CP/M commands are entered if the system disk is set up for WordStar.

To correct this inconvenience, I've written a patch for WordStar that sets the arrow keys to the WordStar codes when it starts and puts them back when it's done.

The Osborne 1 comes with a program called Setup that you can use to change the codes returned when you press the arrow keys. For example, if the system disk is set up for WordStar, the left arrow key generates Control-S instead of Control-H.

There are two obvious ways around the problem. One is to leave the system disk arrow keys set to the CP/M codes and then run Setup before using WordStar. The other is to leave the system disk arrow keys set to the WordStar codes and not use them when entering CP/M commands. (I won't even think of not using them in WordStar.) Both of these solutions irritate me. I can't keep them in mind and work on something else at the same time.

I guess I qualify as a true hacker, because I'd rather write a program than put up with even a small inconvenience day after day. Listing 1 shows two routines that solve this problem. One is called by WordStar to "initialize" the console before anything else is sent to it, and the other "de-initializes" the console before WordStar exits to CP/M.

Sewing the Patch

This patch takes only a few minutes to install if you use the WordStar Install program. (Remember to make a backup of your WordStar disk first!) Its ability to be patched helps make WordStar a really good program. Its complexity may make it hard to learn, but the sophistication allows for solutions to aggravating little problems like this one.

The patches in Listing 1 should work for any version of the Osborne 1 BIOS, although I've been able to test it only on my double-density system, both before and after my Screen Pak upgrade (ROM version 1.44). Owners of very old Osbornes (pre-ROM 1.3 versions) should check to be sure that the offset at ABASE is correct.

You can easily do this by setting the arrow keys to the CP/M codes with Setup and using DDT to look at the ABASE offset into the BIOS. The four bytes starting at ABASE should be 0BH, 0CH, 0AH, 08H. Next use Setup again to change the arrow keys to the WordStar codes. If the four bytes at ABASE have changed to 05H, 04H, 18H and 13H, then the patch should work.

What About Other Systems?

This technique should work on any system or terminal with programmable arrow keys. The code at Start and Exit will be different, but that's just a matter of patching memory (as in Listing 1) or sending commands to the terminal.

Since I've installed the WordStar patch, I haven't thought about the arrow keys. They're set to the CP/M codes except when WordStar is running; then they're set to the WordStar codes. Not many other programs use the WordStar codes for cursor control, and some, like SuperCalc, recognize either. Even if you don't have an Osborne 1 you can use this patch as a starting point for some other terminal.■

Address correspondence to Tim R. Norton, 1107 Southwestern Drive, Richardson, TX 75081.

```
;*****************************************************************
;*                                                               *
;*            PATCH  TO  MAKE WORDSTAR CHANGE THE                *
;*                                                               *
;*            ARROW  KEYS  ON  OSBORNE-1 COMPUTER                *
;*                                                               *
;*  WHEN  WS STARTS THE ARROW KEYS ARE PATCHED TO THE WS VALUES. *
;*  AND WHEN WS ENDS THE ARROW KEYS ARE PATCHED TO THE CPM       *
;*  VALUES, THE CODE AT INISUB: AND UNISUB: IS PATCHED AT THOSE  *
;*  LABELS IN WS.                                                *
;*                                                               *
;*  THE CODE AT START AND EXIT IS PATCHED INTO THE MORPAT: AREA. *
;*  THERE ARE NO JUMPS OR WORK AREA IN EITHER START OR EXIT, SO  *
;*  THE CODE CAN BE PUT AT ANY LOCATION WITHOUT ANY PROBLEMS.    *
;*  ONLY THE JMPS AT INISUB: AND UNISUB: NEED TO BE ADJUSTED.    *
;*  THE ORG ADDRESS USED HERE IS THAT SHOWN IN THE WS 2.2X       *
;*  LISTING OF THE OSBORNE/MC-GRAW HILL BOOK.                    *
;*                                                               *
;*            BY:  TIM R. NORTON                                 *
;*                                                               *
;*****************************************************************

0000              WSPTCH  ORG   0000H
                  ;
       7F 00      ABASE   EQU   0007FH ;  OFFSET TO  ARROW
                  ;                    ;     KEY POINTER IN BIOS.
       01 00      WBOOT   EQU   00001H ;  CP/M WARM  BOOT ADDRESS
                  ;
       05 00      WUARROW EQU   005H   ; WS UP     ARROW CNTL-E
       04 00      WRARROW EQU   004H   ; WS RIGHT  ARROW CNTL-D
       18 00      WDARROW EQU   018H   ; WS DOWN   ARROW CNTL-X
       13 00      WLARROW EQU   013H   ; WS LEFT   ARROW CNTL-S
                  ;
       0B 00      CUARROW EQU   00BH   ; CPM UP     ARROW CNTL-K
       0C 00      CRARROW EQU   00CH   ; CPM RIGHT  ARROW CNTL-L
       0A 00      CDARROW EQU   00AH   ; CPM DOWN   ARROW CNTL-J
       08 00      CLARROW EQU   008H   ; CPM LEFT   ARROW CNTL-H
                  ;
                         ORG   02A4H   ; INISUB: IN WS 2.2X
02A4   C3 E0 02   INISUB: JP    START
                  ;
                         ORG   02A7H   ; UNISUB: IN WS 2.2X
02A7   C3 F8 02   UNISUB: JP    EXIT
                  ;
02E0                     ORG   02E0H   ; START OF MORPAT:  IN
                                       ; WS 2.2X LISTING
                  ;
                  ; *** PATCH USED WHEN WS STARTS       ***
                  ; *** MAKES ARROW KEYS WORDSTAR CODES ***
       E0 02      START   EQU   $
02E0   00                 NOP                ; NOP'S MAKE PATCHING
02E1   00                 NOP                ;    THE PATCH EASIER IF
02E2   00                 NOP                ;    EVER NEEDED
02E3   2A 01 00           LD    HL,(WBOOT)   ; GET ADDRESS OF WBOOT
                          ; GET ADDRESS OF POINTER TO 1ST ARROW KEY
02E6   2E 7F              LD    L,ABASE
02E8   5E                 LD    E,(HL)       ; GET ADDRESS
02E9   23                 INC   HL           ;    OF FIRST
02EA   56                 LD    D,(HL)       ;    ARROW KEY
02EB   EB                 EX    DE,HL        ; MOVE IT TO HL
02EC   36 05              LD    (HL),WUARROW ; STORE WS UP
02EE   23                 INC   HL           ; NEXT ARROW KEY
02EF   36 04              LD    (HL),WRARROW ; STORE WS RIGHT
02F1   23                 INC   HL           ; NEXT ARROW KEY
02F2   36 18              LD    (HL),WDARROW ; STORE WS DOWN
02F4   23                 INC   HL           ; NEXT ARROW KEY
02F5   36 13              LD    (HL),WLARROW ; STORE WS LEFT
02F7   C9                 RET
                  ;
                  ;
                  ; *** PATCH USED WHEN WS ENDS     ***
                  ; *** MAKES ARROW KEYS CPM CODES ***
       F8 02      EXIT    EQU   $
02F8   00                 NOP                ; NOP'S MAKE PATCHING
02F9   00                 NOP                ;    THE PATCH EASIER IF
02FA   00                 NOP                ;    EVER NEEDED
02FB   2A 01 00           LD    HL,(WBOOT)   ; GET ADDRESS OF WBOOT
                          ; GET ADDRESS OF POINTER TO 1ST ARROW KEY
02FE   2E 7F              LD    L,ABASE
0300   5E                 LD    E,(HL)       ; GET ADDRESS
0301   23                 INC   HL           ;    OF FIRST
0302   56                 LD    D,(HL)       ;    ARROW KEY
0303   EB                 EX    DE,HL        ; MOVE IT TO HL
0304   36 0B              LD    (HL),CUARROW ; STORE CPM UP
0306   23                 INC   HL           ; NEXT ARROW KEY
0307   36 0C              LD    (HL),CRARROW ; STORE CPM RIGHT
0309   23                 INC   HL           ; NEXT ARROW KEY
030A   36 0A              LD    (HL),CDARROW ; STORE CPM DOWN
030C   23                 INC   HL           ; NEXT ARROW KEY
030D   36 08              LD    (HL),CLARROW ; STORE CPM LEFT
030F   C9                 RET
                  ;
                  ;
0310                      END   02E0H
```

Listing 1. The first routine "initializes" the console and the second "de-initializes" it.

Cnhy Vf Qrnq!

If you've ever spent a hard day's night puzzling over polyalphabetic substitute machine ciphers, Help is here. Everybody's got something to hide, but this enhanced Basic program will make those scrambled codes come together.

By David Block

This article includes a Basic program designed to assist in breaking a specific type of machine cipher. The application of the program will, with persistence, produce the desired solution, but it may take awhile. Don't say I didn't warn you!

David Kahn's book, *The Codebreakers*, gives a comprehensive history of secret writing; I have taken much of my historical information from there.

Modern cipher machines are based on polyalphabetic substitution, a method of concealing the meaning of messages that was first described by Alberti in the 15th century. Simple substitution ciphers, where each letter of the message is always replaced by the same cipher letter, do not pose much of a problem.

Take, for example, the cipher word, ABCCDEB. It is immediately apparent that it represents a seven-letter word that contains each of two letters twice, one of them a pair of the same letter. If this represents an English word, C must represent one of the letters that is doubled in English words: BCDEF GKLMN OPRST.

This simple observation eliminates 11 of the 26 possibilities. This is how you break ciphers: Reduce the possibilities until only one remains. Taken at face value, a cryptogram of 100 letters has 26^{100} possible solutions, only one of which is correct. But if the simple substitution cipher is not a random group of letters, you can, with the right tools, decipher it. The most useful tools are frequency counts of the letters and their contacts, and tables of pattern words.

Cryptanalysis by Helen Fouche Gaines gives instructions on how to break simple ciphers. Caxton Foster's *Cryptanalysis for Microcomputers* offers useful Basic programs and helpful tables. The possibilites given for ABCCDEB are MESSAGE, TERRACE, TROOPER.

Break in Security

Alberti, whose story is told in *The Codebreakers*, describes polyalphabetic substitution, where several different cipher alphabets are used in rotation according to a fixed plan. For several centuries this method was considered secure. Various cipher machines based on this principle were constructed, among them the disk machine described by Thomas Jefferson around 1800 and the simplified version reinvented by Bazeries in the 1890s.

Based on the assumption that any ciphering system can be broken, many methods of attack on these substitution ciphers have been published. One method that has proved convenient is Kasiski's, which determines the number of cipher alphabets used. Kasiski realized that the reoccurrence of cipher letters or groups of letters are usually found at intervals that are multiples of the number of cipher alphabets used. Once the period of the cryptogram is determined, the cipher is arranged in that number of columns. Then the frequency of the cipher letters in a column can be examined and probable substitutions made.

Cryptologists countered this method of attack by increasing the number of alphabets used. The ultimate has been reached by the pseudorandom key systems in use today. The two correspondents possess identical random number generators or series of random numbers.

The sender conceals his message by enciphering it against the output of his generator, using an agreed-upon seed as the starting point of his random series. The receiver, of course, deciphers the message against his generator after seeding it appropriately.

The disadvantages of this method are twofold. First, no cipher is secure if its machine can be stolen; second, somehow the key must be transmitted to the receiver; this is often as difficult as getting the actual message to him.

Nice Tries

Jefferson's sophisticated cipher machine contained 36 disks, each with a different mixed alphabet on its circumference. The disks were arranged on an axle in an agreed-upon order and then turned until one row spelled out the first 36-letter block of the message.

Any one of the other rows was copied down as the first section of the cryptogram. Then the next block of the message was set into a row and one of the other rows was copied down as the second section of the cryptogram. The receiver set up a row

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of the first 36 letters of the cryptogram, then inspected the other 25 rows to see which one made sense.

Jefferson offered this machine to the Department of War (now called the Department of Defense) but it was rejected as being too complicated.

Jefferson's machine was reinvented by Bazeries late in the nineteenth century. His version had only 20 disks, each containing 25 letters. The French government decided not to adopt this device after the Marquis de Viaris deciphered several test cryptograms made with it. This machine (now with 26 letters per disk) was the subject of an article by Rinaldo Prisco in the June 1983 issue of *BYTE*. I use his Challenge Cryptogram 1 in the following discussion.

Although it appears that any letter in the Bazeries cryptogram can represent any letter of a message, with a little luck and the capture of an enemy machine (in order to learn the sequence of the alphabets on the disks), a series of Basic programs will break the system. My adaptation of de Viaris' method will be described as a manual method before I present the program that applies it.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
1	V	I	I	N	E	G	V	C	V	P	X	Y	Z	A	U	C	U	M	N	K
2	P	Y	B	P	N	A	O	F	T	Z	L	E	E	Q	O	X	B	F	C	Y
3	T	O	K	L	B	P	X	A	N	N	E	Q	D	G	S	D	Q	S	Z	Z
4	G	G	A	K	Y	T	R	M	W	L	T	P	I	F	L	Q	N	G	X	C
5	I	U	M	S	U	Z	I	T	X	I	Y	G	P	D	Y	Y	W	U	W	L
6	B	L	S	A	M	R	F	I	E	M	F	N	G	P	C	O	A	Z	U	U
7	O	M	U	O	Q	X	K	L	G	B	K	B	U	S	D	G	G	E	O	X
8	E	Z	N	G	X	S	B	O	S	Q	Z	R	O	M	J	P	M	Y	G	E
9	Y	F	F	R	A	B	E	W	C	C	S	T	S	L	V	Z	S	X	S	S
10	R	W	L	J	W	Q	C	V	U	J	R	F	M	Y	Q	L	K	R	V	F
11	U	E	E	B	V	D	U	E	P	F	A	V	F	K	X	T	C	V	Y	W
12	F	T	V	U	G	V	Q	P	Y	G	B	O	B	X	B	A	R	I	B	T
13	N	X	Q	Z	L	K	D	U	A	E	N	W	R	Z	T	B	O	C	Q	R
14	W	Q	X	D	J	U	Z	X	D	Y	O	S	X	W	R	U	J	O	F	P
15	A	P	Y	F	S	N	T	S	L	S	U	C	J	J	E	N	P	L	P	Q
16	D	V	G	M	I	Y	A	K	Z	D	P	Z	C	O	F	E	F	Q	J	D
17	L	J	C	X	K	E	L	D	Q	U	C	X	Y	N	K	J	X	K	D	B
18	Z	C	D	Y	P	W	G	R	J	A	Q	D	W	C	W	S	I	P	E	M
19	J	B	O	C	O	F	N	G	K	X	W	L	N	B	N	F	D	B	R	A
20	K	N	Z	V	D	M	S	J	O	T	D	M	V	U	P	V	L	D	I	G
21	M	R	W	Q	T	I	W	Y	I	O	I	I	Q	V	A	K	E	A	K	N
22	Q	A	T	W	Z	C	Y	Z	B	R	J	K	K	E	Z	R	T	N	L	I
23	S	D	P	E	C	O	J	B	R	V	V	U	T	I	M	W	V	J	M	J
24	C	S	J	I	R	J	M	N	M	W	M	J	A	R	I	M	Z	T	A	V
25	X	K	R	T	F	L	P	Q	F	K	G	A	L	T	G	I	Y	W	T	O

Table 1. The 25 generators of H.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
1	D	D	M	O	W	P	L	M	D	X	B	H	L	Q	Z	B	G	N	T	G
2	L	S	S	G	V	T	G	T	L	T	N	Y	H	G	M	U	M	J	H	N
3	Z	K	U	R	G	Z	N	I	Z	O	O	E	Z	F	I	N	S	T	N	I
4	J	H	N	J	L	R	S	L	Q	R	U	Q	E	D	G	E	K	W	C	J
5	K	I	F	B	J	X	W	O	J	V	P	P	D	P	H	J	C	H	Z	V
6	M	Y	L	U	S	S	Y	W	K	W	C	G	I	S	U	S	R	M	X	O
7	Q	O	E	Z	I	B	J	V	O	K	Q	N	P	M	O	F	O	F	W	H
8	S	G	V	D	K	Q	M	E	I	H	W	B	G	L	S	V	J	S	U	K
9	C	U	Q	F	P	D	P	P	B	P	D	R	U	Y	L	K	P	G	O	Y
10	X	L	X	M	O	V	H	U	R	Z	I	T	O	K	Y	R	F	U	G	Z
11	H	M	Y	X	D	K	V	X	M	N	J	F	S	X	C	W	X	Z	S	C
12	V	Z	G	Y	T	U	O	S	F	L	V	V	M	Z	D	M	I	E	V	L
13	P	F	C	C	Z	N	X	K	H	I	M	O	F	W	J	I	D	Y	Y	U
14	T	W	D	V	C	Y	R	D	V	M	G	W	B	J	V	H	L	X	B	X
15	G	E	O	Q	R	E	I	R	T	B	H	S	R	O	Q	C	E	R	Q	E
16	I	T	Z	W	F	W	F	G	N	Q	X	C	X	N	X	X	T	V	F	S
17	B	X	W	E	H	F	K	J	W	C	L	Z	J	C	B	D	V	I	P	F
18	O	Q	T	I	E	M	B	Y	X	J	E	X	C	B	T	Q	Z	C	J	W
19	E	P	P	T	N	I	E	Z	E	F	T	D	Y	U	R	Y	Y	O	D	T
20	Y	V	J	H	B	C	C	B	G	G	Y	L	W	V	E	O	H	L	E	R
21	R	J	R	N	Y	O	U	N	S	E	F	M	N	E	F	G	U	Q	R	P
22	U	C	H	P	U	J	Q	Q	C	Y	K	I	V	I	K	P	B	K	I	Q
23	F	B	I	L	M	L	D	H	U	S	Z	K	Q	R	W	Z	Q	P	K	D
24	N	N	B	K	Q	H	Z	C	P	D	S	U	K	T	N	L	N	B	L	B
25	W	R	K	S	X	G	T	F	Y	U	R	J	T	H	P	T	W	D	M	M

Table 2. The 25 generators of A.

Luck and Hard Work

Perseverance and luck are required for success. As Kahn says, you don't solve a cryptogram just by sitting and looking at it. The luck consists of guessing a word that occurs in the message, or at least a sequence of letters. Circumstance will dictate what you choose. If you have intercepted a secret message you want to read, you'll usually have some idea of the contents.

But in the case of Prisco's challenge, there is no clue as to contents.

Fig. 1 reproduces the cryptogram, rearranged in 20 columns by 12 rows. Assume that you're looking for the word HAVE, for example. Now you must set up tables that will help you test your guess.

The tables have 20 columns, one for each disk. The disks have been rotated to bring the target letter of the table to the first, or zero, row.

Table 1, for example, would be prepared manually by putting the disks on the axle in order, with 1 on the left, then setting one row to all Hs. This row represents letters in the message.

The other 25 rows represent possible substitutions for that first row letter, depending on both the disk used and on the row chosen for that particular column of the message. The rows may be called generators, since they show which cryptogram letters can generate the specified message letter.

You should then proceed to find possible locations for HAVE by working through each letter of each line of the cipher with each cipher row of the disks. Since each block of 20 letters in the cryptogram came from a single row on the device, all of these letters must be found in the same generators.

Stage One

Beginning with the first generator rows, you find that H can be represented by one of these letters: ACEGI KMNPU VXYZ. The third letter of the cryptogram, U, is therefore the first place HAVE could begin if generator 1 was used for the first line, making UZKM = HAVE.

Column 3 of the cryptogram will then be disk 15 or 17, since U occurs in only the 15th and 17th positions in the first generator of H. Z must now be A; from Table 2 we find that only disk 15 will work. Since each disk can be used in only one place, 15 is ruled out for the H column. Similarly, Table 3

O	S	U	Z	K	M	T	K	L	Z	Y	F	Y	V	T	M	D	H	K	T
Q	W	W	I	B	D	M	Z	J	A	N	Z	N	T	W	D	B	V	B	H
W	G	P	D	D	H	B	P	Z	C	R	J	M	D	S	W	N	Z	T	H
F	P	V	O	B	M	V	E	R	U	A	T	T	H	C	I	Y	L	N	T
Y	X	S	D	O	Y	Z	K	X	U	Y	P	S	W	B	U	H	Z	X	J
K	R	Y	V	Y	H	A	N	N	G	Q	Z	V	L	M	C	R	H	I	J
V	B	Z	O	I	H	B	V	C	E	F	P	M	C	C	O	P	I	S	G
X	M	B	L	C	Z	M	C	T	O	X	T	W	D	G	Y	E	C	V	U
U	W	Y	I	Q	Q	F	Y	H	W	M	D	Z	P	K	A	U	U	R	T
K	S	N	Z	O	C	S	S	D	Z	J	B	P	M	N	D	B	P	P	W
S	C	F	F	B	L	A	D	X	K	D	P	H	O	A	D	E	E	B	A
G	K	N	B	G	L	E	L	N	D	J	B	A	Z	M	O	J	U	D	O

Fig. 1. The Challenge Cryptogram: Is this English?

	20	7	17	1	20	7	17	1	20	7	17	1
0	Z	J	A	N	P	Z	C	R	E	R	U	A
1	C	M	G	W	Q	T	R	U	S	I	B	D
2	L	P	M	A*	D	A	O	F	F	F	Q	L
3	U	H	S	D	B	L	J	N	W	K	N	Z
4	X	V	K	L	M	G	P	W	T	B	W	J
5	E	O	C	Z	A	N	F	A*	R	E	A	K
6	S	X	R	J	G	S	X	D	P	C	G	M
7	F	R	O	K?	N	W	I	L*	Q	U	M	Q
8	W	I	J	M	I	Y	D	Z	D	Q	S	S
9	T	F	P	Q	J	J	L	J	B	D	K	C
10	R	K	F	S	V	M	E	K	M	Z	C	X
11	P	B	X	C	O	P	T	M?	A	T	R	H?
12	Q	E	I	X	H	H	V	Q	G	A	O	V
13	D	C	D	H	K	V	Z	S	N	L	J	P
14	B	U	L	V	Y	O	Y	C	I	G	P	T
15	M	Q	E	P	Z	X	H	X	J	N	F	G
16	A	D	T	T	C	R	U	H?	V	S	X	I
17	G	Z	V	G	L	I	B	V?	O	W	I	B?
18	N	T	Z	I	U	F	Q	P	H	Y	D	O?
19	I	A	Y	B	X	K	N	T	K	J	L	E
20	J	L	H	O	E	B	W	G	Y	M	E	Y
21	V	G	U	E	S	E	A	I	Z	P	T	R
22	O	N	B	Y	F	C	G	B	C	H	V	U
23	H	S	Q	R	W	U	M	O	L	V	Z	F
24	K	W	N	U	T	Q	S	E	U	O	Y	N
25	Y	Y	W	F	R	D	K	Y	X	X	H	W

Fig. 2. Three attempts to verify that KLZY= HAVE.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
1	P	J	Q	Q	G	K	O	E	T	W	M	O	Q	E	Q	K	Z	I	Y	O
2	T	C	X	W	L	U	X	P	N	K	G	W	K	I	X	R	Y	C	B	H
3	G	B	Y	E	J	N	R	U	W	H	H	S	T	R	B	W	H	O	Q	K
4	I	N	G	I	S	Y	I	X	X	P	X	C	A	T	T	M	U	L	F	Y
5	B	R	C	T	I	E	F	S	E	Z	L	Z	L	H	R	I	B	Q	P	Z
6	O	A	D	H	K	W	K	K	G	N	E	X	H	A	E	H	Q	K	J	C
7	E	D	O	N	P	F	B	D	S	L	T	D	Z	Q	F	C	N	P	D	L
8	Y	S	Z	P	O	M	E	R	C	I	Y	L	E	G	K	X	W	B	E	U
9	R	K	W	L	D	I	C	G	U	M	F	M	D	F	W	D	A	D	R	X
10	U	H	T	K	T	C	U	J	P	B	K	I	I	D	N	Q	G	A	I	E
11	F	I	P	S	Z	O	Q	Y	Y	Q	Z	K	P	P	P	Y	M	N	K	S
12	N	Y	J	A	C	J	D	Z	A	C	S	U	G	S	A	O	S	J	L	F
13	W	O	R	O	R	L	Z	B	D	J	R	J	U	M	Z	G	K	T	M	W
14	A	G	H	G	F	H	T	N	L	F	A	A	O	L	M	P	C	W	A	T
15	D	U	I	R	H	G	A	Q	Z	G	B	H	S	Y	I	Z	R	H	T	R
16	L	L	B	J	E	A	L	H	Q	E	N	Y	M	K	G	L	O	M	H	P
17	Z	M	K	B	N	P	G	C	J	Y	O	E	F	X	H	T	J	F	N	Q
18	J	Z	A	U	B	T	N	F	K	S	U	Q	B	Z	U	A	P	S	C	D
19	K	F	M	Z	Y	Z	S	A	O	D	P	P	R	W	O	B	F	G	Z	B
20	M	W	S	D	U	R	W	M	I	U	C	G	X	J	S	U	X	U	X	M
21	Q	E	U	F	M	X	Y	T	B	A	Q	N	J	O	L	N	I	Z	W	A
22	S	T	N	M	Q	S	J	I	R	X	W	B	C	N	Y	E	D	E	U	G
23	C	X	F	X	X	B	M	L	M	T	D	R	Y	C	C	J	L	Y	O	N
24	X	Q	L	Y	A	Q	P	O	F	O	I	T	W	B	D	S	E	X	G	I
25	H	P	E	C	W	D	H	W	H	R	J	F	N	U	J	F	T	R	S	J

Table 3. The 25 generators of V.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
1	Y	T	V	I	N	W	C	P	G	Y	T	Q	D	I	F	J	T	Y	R	S
2	R	X	Q	T	B	F	U	U	S	S	Y	P	I	R	K	S	V	X	I	F
3	U	Q	X	H	Y	M	Q	X	C	D	F	G	P	T	W	F	Z	R	K	W
4	F	P	Y	N	U	I	D	S	U	U	K	N	G	H	N	V	Y	V	L	T
5	N	V	G	P	M	C	Z	K	P	A	Z	B	U	A	P	K	H	I	M	R
6	W	J	C	L	Q	O	T	D	Y	X	S	R	Q	A	R	U	C	A	P	
7	A	C	D	K	X	J	A	R	A	T	R	T	S	G	Z	W	B	O	T	Q
8	D	B	O	S	A	L	L	G	D	O	A	F	M	F	M	M	Q	L	H	D
9	L	N	Z	A	W	H	G	J	L	R	B	V	F	D	I	I	N	Q	N	B
10	Z	R	W	O	V	G	N	Y	Z	V	N	O	B	P	G	H	W	K	C	M
11	J	A	T	G	G	A	S	Z	Q	W	O	W	R	S	H	C	A	P	Z	A
12	K	D	P	R	L	P	W	B	J	K	U	S	X	M	U	X	G	B	X	G
13	M	S	J	J	J	T	Y	N	K	H	P	C	J	L	O	D	M	D	W	N
14	Q	K	R	B	S	Z	J	Q	O	P	C	Z	C	Y	S	Q	S	A	U	I
15	S	H	H	U	I	R	M	H	I	Z	Q	X	Y	K	L	Y	K	N	O	J
16	C	I	I	Z	K	X	P	C	B	N	W	D	W	X	Y	O	C	J	G	V
17	X	Y	B	D	P	S	H	F	R	L	D	L	N	Z	C	G	R	T	S	O
18	H	O	K	F	O	B	V	A	M	I	I	M	V	W	D	P	O	W	V	H
19	V	G	A	M	D	Q	O	M	F	M	J	I	Q	J	J	Z	J	H	Y	K
20	P	U	M	X	T	D	X	T	H	B	V	K	K	O	V	L	P	M	B	Y
21	T	L	S	Y	Z	V	R	I	V	Q	M	U	T	N	Q	T	F	F	Q	Z
22	G	M	U	C	C	K	I	L	T	C	G	J	A	C	X	A	X	S	F	C
23	I	Z	N	V	R	U	F	O	N	J	H	A	L	B	B	B	I	G	P	L
24	B	F	F	Q	F	N	K	W	W	F	X	H	H	U	T	U	D	U	J	U
25	O	W	L	W	H	Y	B	V	X	G	L	Y	Z	V	R	N	L	Z	D	X

Table 4. The 25 generators of E.

shows that either disk 6 or disk 14 will produce V from K. But you now discover that no generator 1 will produce E from M (Table 4). So, UZKM does not represent HAVE if the first line was enciphered by generator 1.

That is how the first stage of de Viaris' method works: find a possible location for your probable word. It's just the sort of thing computers were built to do. The Marquis de Viaris claimed that a man who had the device could perform this operation in less time than it takes to explain how to do it, but he didn't mention the fact that it would have to be done hundreds of times.

Stage Two

It doesn't take long to discover that the first possible location of HAVE in the cryptogram is KLZY, columns 8 through 11, first line (Fig. 1). It is thus tentatively established that these four columns were enciphered by some combination of the disks 20; 7 or 13; 17; 1, 10 or 18.

The 25 possible decryptions of the next line of the cipher can be found by trying each combination of these disks in turn. Then you have to decide whether one of these lines is, in fact, part of an English message. If it is, then you know which disks were used for these columns and can proceed to decipher the four columns completely.

In this case, when disks 20, 7, 17, and 1 are set to ZJAN (the letters just below KLZY in Fig. 1), rows such as CMGW, LPMA, UHSD, XVKL, EOCZ, and SXRJ are found. A possibility is LPMA (perhaps HELP MAY), from the second generators, although there is also the remote possiblity of FROK, from the number 7 generators. The possibilities for PZCR and the other letters in these columns must also be examined. Only where the disks have been chosen correctly for the columns being investigated will all lines of the cryptogram yield fragments of English words. (See Fig. 2 for the beginning of this testing.)

Enter the Computer

The computer can find possible locations for your guess and offer tentative solutions for the other lines in the columns, but you have to decide whether or not to pursue a tentative solution. It would take a Basic program too long to apply a set of rules, such as reject any solution in which Q is not followed by U or in which J comes between two other consonants. The National Security Agency can do that on their large and fast computers, but interpreted Basic has a few limitations.

In the case of Prisco's cipher, however, he has made things a little easier. To simplify his challenge, he chose to use the generators in an orderly manner, so you know that if, for example, the computer finds a possible location in line 4, then the generator must be reduced by one for the following line or increased by one for the previous line. You can tell the computer about this and reduce the output by 96 percent. This has been done in Listing 1.

That's how the program cracks a simple machine cipher. As I said, you must know the alphabets of the rotors. You could steal them (send an agent clever enough to conceal his theft so the enemy won't change his rotors and thus nullify the theft) or duplicate the feat performed by Marian Rejewski in 1932. He analyzed a great number of intercepted Enigma messages and from them calculated the alphabets used on the rotors of that machine (see *The Enigma War* by Josef Garlinski). An even greater feat was performed by William Friedman, who broke the Japanese diplomatic cipher machine called Purple (see *The Man Who Broke Purple* by Ronald Clark). In the military case, always assume that the enemy has a copy of your machine, even though he may not possess men of the caliber of Rejewski or Friedman.

```
   5 128          15   6   1  14   4  20
WHJKMZ  AOWOUG  NTSIRB  TTYTEF  RTESTU  EDHRRG  LETTER  HJVPCL  IFOAOI  APRSLU
IJUECB  PZBDNS
   5 128          15   6   1  14   9  20
WHJKHZ  AOWOLG  NTSIQB  TTYTHF  RTESSU  EDHRYG  LETTER  HJVPBL  IFOAGI  APRSDU
IJUETB  PZBDYS
   5 128          15   6  13  14   4  20
WHEKMZ  AOTOUG  NTJIRB  TTPTEF  RTISTU  EDERRG  LETTER  HJEPCL  IFFAOI  APNSLU
IJRECB  PZNDNS
   5 128          15   6  13  14   9  20
WHEKHZ  AOTOLG  NTJIQB  TTPTHF  RTISSU  EDERYG  LETTER  HJEPBL  IFFAGI  APNSDU
IJRETB  PZNDYS
   5 128          15   6  16  14   4  20
WHLKMZ  AOTOUG  NTHIRB  TTATEF  RTTSTU  EDDRRG  LETTER  HJHPCL  IFEAOI  APCSLU
IJAECB  PZFDNS
   5 128          15   6  16  14   9  20
WHLKHZ  AOTOLG  NTHIQB  TTATHF  RTTSSU  EDDRYG  LETTER  HJHPBL  IFEAGI  APCSDU
IJAETB  PZFDYS
```

Fig. 3. A close miss when trying VCEFPM = LETTER.

```
   5 128          15   7   1  14   5  19
WGJKHB  AYWOTH  NDSILL  TOYTOM  RHESSU  ETHRPU  LITTLE  HEVPST  INOALL  AIRSTO
ISUEAD  PEBDOF
   5 128          15   7   1  14   8   5
WGJKAU  AYWOYE  NDSIGU  TOYTAO  RHESWG  ETHRRQ  LITTLE  HEVPQY  INOAVS  AIRSSW
ISUEAK  PEBDUF
   5 128          15   7   1  14   8  19
WGJKAB  AYWOYH  NDSIGL  TOYTAM  RHESWU  ETHRRU  LITTLE  HEVPQT  INOAVL  AIRSSO
ISUEAD  PEBDUF
   5 128          15   7  13  14   5  19
WGEKHB  AYTOTH  NDJILL  TOPTOM  RHISSU  ETERPU  LITTLE  HEEPST  INFALL  AINSTO
ISREAD  PENDOF
   5 128          15   7  13  14   8   5
WGEKAU  AYTOYE  NDJIGU  TOPTAO  RHISWG  ETERRQ  LITTLE  HEEPQY  INFAVS  AINSSW
ISREAK  PENDUF
   5 128          15   7  13  14   8  19
WGEKAB  AYTOYH  NDJIGL  TOPTAM  RHISWU  ETERRU  LITTLE  HEEPQT  INFAVL  AINSSO
ISREAD  PENDUF
   5 128          15   7  16  14   5  19
WGLKHB  AYTOTH  NDHILL  TOATOM  RHTSSU  ETDRPU  LITTLE  HEHPST  INEALL  AICSTO
ISAEAD  PEFDOF
   5 128          15   7  16  14   8   5
WGLKAU  AYTOYE  NDHIGU  TOATAO  RHTSWG  ETDRRQ  LITTLE  HEHPQY  INEAVS  AICSSW
ISAEAK  PEFDUF
   5 128          15   7  16  14   8  19
WGLKAB  AYTOYH  NDHIGL  TOATAM  RHTSWU  ETDRRU  LITTLE  HEHPQT  INEAVL  AICSSO
ISAEAD  PEFDUF
```

Fig. 4. VCEFPM must stand for LITTLE.

```
   5 134          11  20   1   4  18   6
MRQFMU  EFAJRS  WENHUP  MYTMCK  PPEEST  MPKSNE  BOPEEP  OPTXER  SGESTL  PRELRI
YFODTH  MESHAG
   5 134          11  20   1   9  18   6
MRQLMU  EFAIRS  WENTUP  MYTUCK  PPERST  MPKKNE  BOPEEP  OPTHER  SGENTL  PREDRI
YFORTH  MESSAG
   5 134          11  20   1  15  18   6
MRQJMU  EFAXRS  WENWUP  MYTSCK  PPEMST  MPKQNE  BOPEEP  OPTVER  SGEPTL  PRELRI
YFOCTH  MESIAG
   5 134          11  20   4   9  18   6
MRXLMU  EFZIRS  WEQTUP  MYWUCK  PPRRST  MPFKNE  BOPEEP  OPUHER  SGTNTL  PRADRI
YFSRTH  MEESAG
   5 134          11  20   4  15  18   6
MRXJMU  EFZXRS  WEQWUP  MYWSCK  PPRMST  MPFQNE  BOPEEP  OPUVER  SGTPTL  PRALRI
YFSCTH  MEEIAG
```

Fig. 5. Of course CCOPIS = BOPEEP.

Where Next?

Once the columns containing the identified rotors have been deciphered, the rest is simple. In the case of Prisco's cipher, the solution comes about from a test for the word LETTER. Fig. 3 shows part of the result of that search which leads to trying LITTLE, with part of the result of that in Fig. 4. The computer is using the fifth generators and starting the test word at character 128 in the cipher. The other six numbers are the disks (rotors) it is using.

The fourth group in Fig. 4 looks good. The parameters of the program were altered to limit the program to trying BOPEEP at character 134 (suggested by JILL in line 3). You can see from Fig. 5 that all that remains is to wrap up the loose ends. The failure of the computer to use the proper generator for line 1 has to be tidied up, and the remaining columns can be worked out as an exercise (see Fig. 6).

Bigger Problems

The program method can be applied to ciphers from more advanced machines, such as the Enigma. The generators will be much longer, so your preliminary searches for possible locations should use pointer files to the generators. Instead of the internal verification used here, a parallel message must serve for testing. This presupposes that you have enough intercepted messages so that two of them have been enciphered using the same keys. This would be determined by Friedman's index of coincidence, now

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called the kappa test, explained in both Foster's and Kahn's books.

To find two such Enigma messages you'll probably have to examine about 60 messages; during World War II hundreds were intercepted every day. The enormous traffic necessary in wartime makes it impossible to use onetime keys, once the only secure method. Today the RSA trapdoor algorithm (*BYTE*, January 1983) is the only reliable and practical way to go.

```
O S U Z K M T K L Z Y F Y V T M D H K T
              I M O N:M E T:A:P I E M
Q W W I B D M Z J A N Z N T W D B V B H
              A Y:T O:T H E:F A I R:S
W G P D D H B P Z C R J M D S W N Z T H
              N D:J I L L:W E N T:U P
F P V O B M V E R U A T T H C I Y L N T
              T O P:T O M M Y:T U C K
Y X S D O Y Z K X U Y P S W B U H Z X J
              R:H I S:S U P P E R:S T
K R Y V Y H A N N G Q Z V L M C R H I J
              E T E R:P U M P K K N:E
V B Z O I H B V C E F P M C C O P I S G
              L I T T L E:B O P E E P
X M B L C Z M C T O X T W D G Y E C V U
              H E E P:S T O P:T H E:R
U W Y I Q Q F Y H W M D Z P K A U U R T
              I N:F A L L S:G E N T L
K S N Z O C S S D Z J B P M N D B P P W
              A I N:S T O P:R E D:R I
S C F F B L A D X K D P H O A D E E B A
              I S:R E A D Y:F O R:T H
G K N B G L E L N D J B A Z M O J U D O
              P:E N D:O F:M E S S A G
```

Fig. 6. Colons have been added to separate the words.

Practical Details About Listing 1

The program (written in TSC's extended Basic) requires you to set up various disk files in advance. ARRAY1 is a random file containing the 25 generators for each of the 26 letters of the alphabet, so it will require about 12Kb. I didn't have room for it in memory so I used the virtual memory feature of my Basic (lines 50, 70 and 280). Listing 2 shows how I set up that file. Once the random file has been opened and dimensioned, references to elements in it cause automatic reading or writing of them.

The cryptogram is stored in a simple sequential file, 12 strings of 20 characters each. The 20 alphabets of the rotors are stored as 26-letter strings in another file.

The listing as given is basically set up to seek eight-letter words, but it has been modified (lines 320, 560 and 1010) for use with six-letter words. The longer the search word, the fewer the possible locations and the shorter the search. My computer took three hours or more to handle a four-letter word and I estimate that a three-letter word such as THE would take 70 hours or more. Line 320 prevents looking at locations where the sought word starts on one line and finishes on the next, since in that case the generator of the second part can be any of the 25, leading to an unmanageable number of possibilities.

As it is, my computer offered about 960 suggestions for TION. That was before I realized that longer words have fewer possibilities. It does get to you after a while, watching nonsense string after nonsense string appear on the monitor screen. It makes you marvel that Friedman recovered from the nervous breakdown he suffered after breaking Purple.

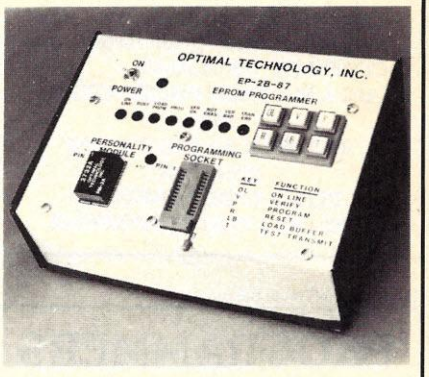
But I cannot describe the thrill that comes from finally seeing a string that makes sense and realizing that your computer has actually done it. It is even worth the time and effort!■

Listing 1. A program to help solve a machine cipher.

```
10 PRINT #0,
20 REM BREAK34, SIX LETTER WORDS
30 DIM E$(20),R$(20),W$(20)
40 OPEN "ARRAY1" AS 1
50 DIM #1, G$(676)=20
60 OPEN "ARRAY3" AS 3
70 DIM #3, D$(20)=26
80 FOR I=1 TO 20:E$(I)=D$(I):NEXT I
90 CLOSE 3
100 DIM D$(20)
110 INPUT "Name of cipher file ",Q$
120 OPEN OLD Q$ AS 4
130 FOR I=1 TO 12
140 INPUT #4, E$
150 C$=C$+E$
160 NEXT I
170 L=LEN(C$)
180 INPUT "Possible word ",W$
190 LW=LEN(W$)
200 FOR I=1 TO LW
210 W$(I)=MID$(W$,I,1)
220 NEXT I
230 FOR G=1 TO 25
240 PRINT G
250 REM:GET THE APPROPRIATE GENERATORS FOR THE TEST WORD
260 FOR I=1 TO LW
270 T=ASC(W$(I))-64
280 R$(I)=G$((T-1)*26+G)
290 NEXT I
300 REM:TEST EVERY POSSIBLE LOCATION IN THE CIPHER
310 FOR S=1 TO L-LW+1
320 IF S-INT(S/20)*20=16 THEN S=S+5:REM SKIP IF WORD RUNS OVER
330 T1$=MID$(C$,S,1)
340 FOR P1=1 TO 20
350 IF MID$(R$(1),P1,1)<>T1$ THEN 750
360 T2$=MID$(C$,S+1,1):REM          Find second letter substitution
370 FOR P2=1 TO 20
380 IF MID$(R$(2),P2,1)<>T2$ THEN 740
390 IF P2=P1 THEN 740 :REM: Here and later disks can be used but once
400 T3$=MID$(C$,S+2,1):REM        Find third letter substitution
410 FOR P3=1 TO 20
420 IF MID$(R$(3),P3,1)<>T3$ THEN 730
430 IF P3=P2 OR P3=P1 THEN 730
440 T4$=MID$(C$,S+3,1):REM       Find fourth substitution letter
450 FOR P4=1 TO 20
460 IF MID$(R$(4),P4,1)<>T4$ THEN 720
470 IF P4=P3 OR P4=P2 OR P4=P1 THEN 720
480 T5$=MID$(C$,S+4,1):REM       Find fifth substitution letter
490 FOR P5=1 TO 20
500 IF MID$(R$(5),P5,1)<>T5$ THEN 710
510 IF P5=P4ORP5=P3ORP5=P2ORP5=P1 THEN 710
```

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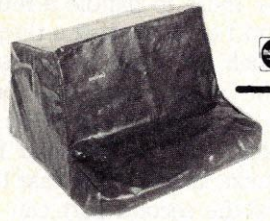
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Listing 1 continued.

```
520 T6$=MID$(C$,S+5,1):REM        Find sixth substitution letter
530 FOR P6=1 TO 20
540 IF MID$(R$(6),P6,1)<>T6$ THEN 700
550 IF P6=P5ORP6=P4ORP6=P3ORP6=P2ORP6=P1 THEN 700
560 GOTO 660
570 T7$=MID$(C$,S+6,1):REM        Find seventh substitution letter
580 FOR P7=1 TO 20
590 IF MID$(R$(7),P7,1)<>T7$ THEN 690
600 IF P7=P6ORP7=P5ORP7=P4ORP7=P3ORP7=P2ORP7=P1 THEN 690
610 PRINT P7;
620 T8$=MID$(C$,S+7,1):REM        Find eighth substitution letter
630 FOR P8=1 TO 20
640 IF MID$(R$(8),P8,1)<>T8$ THEN 680
650 IF P8=P7ORP8=P6ORP8=P5ORP8=P4ORP8=P3ORP8=P2ORP8=P1 THEN 680
660 GOTO 800
670 GOTO 760
680 NEXT P8
690 NEXT P7
700 NEXT P6
710 NEXT P5
720 NEXT P4
730 NEXT P3
740 NEXT P2
750 NEXT P1
760 NEXT S
770 NEXT G
780 GOTO 180
790 REM: If this point is reached there is a tentative solution
800 PRINT #0, USING "####",G;S,P1;P2;P3;P4;P5;P6
810 REM: Load in the disk alphabets in the order just established
820 D$(1)=E$(P1):D$(2)=E$(P2):D$(3)=E$(P3):D$(4)=E$(P4)
830 D$(5)=E$(P5):D$(6)=E$(P6):D$(7)=E$(P7):D$(8)=E$(P8)
840 REM: Now decipher the columns using the current generators
850 FOR RR=0 TO 220 STEP 20
860 CC=S-INT((S-1)/20)*20
870 FOR D=1 TO LW
880 T9$=MID$(C$,RR+CC+D-1,1):REM     Get a cipher letter
890 FOR QQ=1 TO 26
900 IF MID$(D$(D),QQ,1)<>T9$ THEN NEXT QQ:REM Find it on rotor
910 SS=QQ-G-RR/20+INT(S/20):REM  Count back to message letter
920 IF SS=QQ THEN SS=QQ-1
930 IF SS<1 THEN SS=SS+26:GOTO 930
940 IF SS>26 THEN SS=SS-26
950 AN$=AN$+MID$(D$(D),SS,1)
960 NEXT D
970 PRINT #0, AN$;"  ";
980 AN$=""
990 NEXT RR
1000 PRINT #0,:REM NEXT LINE
1010 GOTO 700:REM Resume examination of possiblities
```

```
10 REM- LISTING 2, PREPARATION OF GENERATOR FILES
20 DIM D$(20), T$(20), GE$(26)
30 OPEN OLD "DISKFILE" AS 1
40 OPEN "ARRAY1" AS 3
50 DIM #3, G$(676)=26
60 FOR I=1 TO 20
70 INPUT #1, D$(I)
80 NEXT I
90 CLOSE 1
100 REM Do a generator set for each letter
110 FOR A=1 TO 26
120 FOR D=1 TO 20:REM rearrange disk alphabets so
125 REM                current letter is first.
130 A$=D$(D)
140 B$=D$(D)
150 FOR G=1 TO 26
160 IF ASC(A$)=(64+A) THEN 190
170 A$=MID$(A$,2)
180 NEXT G
190 T$(D)=MID$(B$,G+1)+MID$(B$,2,G-2)
200 NEXT D
205 REM Now pick off the generators and store them
210 FOR GG=1 TO 25
220 FOR KK=1 TO 20
230 GE$(GG)=GE$(GG)+MID$(T$(KK),GG+1,1)
240 NEXT KK
250 G$((A-1)*26+GG)=GE$(GG)
260 GE$(GG)=""
270 NEXT GG
280 NEXT A
```

Listing 2. A program to prepare a source file for Listing 1.

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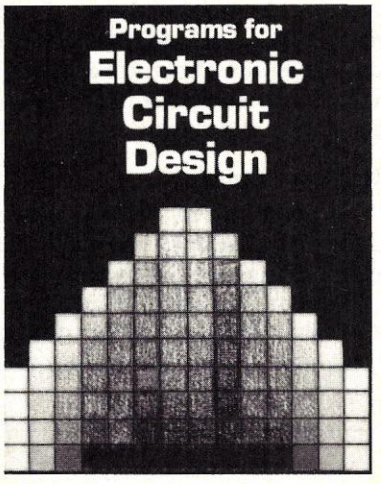
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Can't Decide?

If you're one of those people who just can't make a decision, the Decision Aid program may offer the prompting that you need. Using a simple mathematical technique, this program offers a methodical, orderly process for weighing your options.

By Robert Belanger

The Decision Aid program is a decision-making utility designed to help you evaluate options and alternatives using a simple mathematical technique. Whether you're making a personal choice or considering a business decision, this program helps you by providing a methodical, orderly process for weighing your options.

The mathematics is elementary and follows the general scheme you use at an intuitive level. First, you define your options. Then you enumerate the criteria to be used in judging these options. Next, you specify the weight you wish to assign to each of the criteria. The last step is to rate each of the options on each of the criteria.

The weighted score for each option is then computed by multiplying each rating by its corresponding weight and summing the products across all of the criteria. The weighted total scores are then listed in descending order to show the relative attractiveness of each option at a glance.

Multiple Choices

This program can be used in many settings. For example, you can use it to select a new home, a new car or an investment opportunity. Your children can make college selection decisions or evaluate career change options. At work, you can use it to decide whether to buy or lease capital equipment and facilities, to compare the performance of subcontractors or to evaluate the productivity of your employees.

If you're not sure of a rating or of which weighting to use with one or more of the criteria, you can use a technique called sensitivity analysis. Using this technique, you rerun the analysis, changing the questionable rating or weighting by plus and minus one. If the resulting sorted listing of options differs greatly as a result of these changes, you know that better information will make a difference. Perhaps better information can be obtained by paying for external research results, by hiring a consultant to perform a study or by simply digging harder into your sources of information. It's reassuring to know up front, via sensitivity analysis, that this effort and expense is justified.

Key Features

This program has the following key features:

- All inputs are prompted by screen messages.
- Only valid responses are accepted for the prompts.
- After each screen of input, you're asked if it's OK to go on, which gives you the chance to make changes without having to start over at the very beginning.
- Up to ten options may be specified (15 characters).
- Up to ten criteria may be named (15 characters).
- Each of the criteria may be weighted from one to nine (from extremely unimportant to extremely important).

Line	Lines Summary
10	program title and purpose
110	describes key variables and constants
360	is the main routine that supervises the operation of the entire program
590	asks if the user is satisfied with the screen data as it stands
670	is where the user can change the printer slot allocation from Slot 1, if the printer is located in any other slot
730	is used to control the spacing during the printing of the final report (The screen report is single-spaced while the printer report is double-spaced to fill an 8½ by 11-inch sheet in an easy-to-read format.)
780	prints the program banner
900	prints the general instructions for the user
1170	gets the two title lines for headers on the report
1440	is used to read in the names of the options and to count the number of options being analyzed
1750	is used to read the names of the criteria and to count the number of criteria being used
2060	is used to obtain the weights for the criteria
2460	reads the scores for each of the criteria for each option being analyzed
2890	computes the total weighted score for each option
3170	sorts the list of options into descending order of weighted total scores
3770	is used to print a report on the screen or to a printer
4510	asks if a report is desired, and when the report is finished, asks if another analysis is required.

Table 1. Outline of functions performed by sections of the code.

- The rating scores can be anywhere from one to nine (from extremely poor to extremely good).
- Two title lines are provided for easy identification of analyses (27 characters each).
- A one-page clearly organized report is available either on screen or paper, showing the options, criteria, weightings, ratings, total scores and sorted listing of the options.

Criteria Selection

In evaluating any decision, several types of criteria must be considered. First are those that relate to physical or economic constraints, such as the purchase cost of an item, or the size, weight and dimensions of a physical object. Such constraints relate to limited resources of space, time, cash, energy, labor or other resources.

Second, you might consider the effectiveness criteria, such as the performance characteristics of an automobile or the income-yielding potential of an investment. The price-to-earnings ratio is an additional example of this type of criteria. Generally, it relates to the ability to get the right job done, whatever that job happens to be.

A third type of criteria is the efficiency of the option. For example, two investment options might have equal levels of effectiveness, measured by the income-yielding potential, but they differ widely in the time required to reach maturity. This type of criteria has the characteristic of timeliness, rate of accomplishment or speed.

How to . . .

This program is designed to make entry of this data as easy as possible. The computer takes over the tedious bookkeeping chores; after all, that's what computers do best. The input you type in is carefully evaluated for validity and rejected if it is illegal. The ability to repeat every screen before going on decreases the risk of having to start over at the very beginning.

Instructions for each screen are printed at the top of the screen and remain there for easy reference during the data-entry process. During the sorting of the weighted total scores, the updating of the list of options into the final form takes place in steps.

At each step, as an option is moved to a new position in the list, you're shown which option is being moved by the presence of an asterisk next to it. This asterisk disappears when the option is moved to the new position. You can be entertained by watching the movement of the options up and down in the list. For ten options, a simple bubble sort is adequate.

Name of the Variable	
CR$(I)	String array of criteria names (I=criteria no.)
FI$	Boolean variable for end-of-study (TRUE = finished with study)
I	Local index variable
IN$	Input character string variable
J	Local index variable
K	Local index for criteria count
KY(I)	Sorting key index (I=option no.)
LI	Line number on the screen
MC	Maximum number of criteria
MO	Maximum number of options
NC	Actual number of criteria used
NO	Actual number of options used
NS(I,J)	Array with sorted scores for Ith option and Jth criterion
OP$(I)	String array with option names (I=option no.)
P$	String variable for report (P=printer S=screen)
R$	String variable for response to questions
SC(I,J)	Array with scores as orignally entered for Ith option and Jth criterion
SO$	Boolean variable for options (TRUE=sorted)
ST$(I)	String array for printing asterisks in sorting
T1	Sorting variable for swapping options
T2$	Sorting variable for option name
T3	Sorting variable for option key
TI$(I)	String array for titles
TS(I)	Array of total scores for options (I=option no.)
WT(J)	Array of criteria weights (J=criterion no.)

Table 2. List and description of the variables used in this program.

How the Program Works

This program began as a Pascal project. Therefore, it contains some of the top-down structure of such programs. The following characteristics are especially important in making the code easy to read and understand:

- The variables and constants are defined at the beginning, after the statement of title and purpose.
- The whole program is supervised from a short main routine module.
- Data entry, computation, sorting and reporting functions are contained in small modules (subroutines called by Gosubs).

Such a modular, top-down structure makes customizing easy, compared to the usual approach to coding. For example, if you want to provide the capability of storing results in disk files, the changes begin at the main routine (lines 360–580) with a call to the filing module:

```
490 GOSUB 2890: REM COMPUTE TOTAL SCORES
500 GOSUB 3170: REM SORT TOTALS
*505 GOSUB 5000: REM DISK STORAGE ROUTINE
510 GOSUB 4510: REM TERMINATION
```

The details of the disk storage module at line 5000 also evolve by stepwise refinements to more detailed levels until the closing level is reached. For example, the pseudocode for the disk storage might read:

- Ask if the user wants to file anything to disk, IF the answer is NO THEN RETURN, ELSE find out what is to be filed.
- Ask the user for filenames,
- OPEN the files,
- WRITE the data to the files,
- CLOSE the files,
- RETURN.

Such filing capability isn't necessary, since most analyses are completed at a single sitting. However, you may want to add some other features. You'll find such modifications easy to incorporate into the existing skeletal structure of the program.

An outline of the functions performed by sections of the code is shown in Table 1.

An Example Analysis

Let's assume you're interested in purchasing a security system for your Apple computer to protect it against theft and keep unauthorized persons from accessing confidential company data. Many such systems are on the market from a number of manufacturers, as you know if you read computer literature. Say you have selected nine systems for consideration before selecting one for your particular application. You call these systems by the coded names System A, System B and so forth to avoid using actual names of manufacturers.

Next, you specify the criteria that you want to use in evaluating these systems. I used the list in Example 1, but you may want to use different criteria in your analysis.

Before the rating process starts, you tell the computer how important each of these criteria is. These measures of relative importance are the weights. The weights used are in Example 2.

The weights are assigned using a scale of one through nine, where one means the criterion is extremely unimportant, five means average importance and nine means extremely important—of course intermediate values can be assigned if the weight falls between these three key weights.■

Address correspondence to Robert Belanger, 35 Charlotte Ave., Cincinnati, OH 45215.

1)	Purchase Price	9
2)	Keylock Power	8
3)	Theft Protection	8
4)	Access Protection	8
5)	Peripheral Security	8
6)	Surge Suppression	7
7)	Power Outlets	5
8)	Fan System	4
9)	Construction	9
10)	Styling and Color	2

Example 2. Weights used for the criteria in Example 1.

1) Purchase Price
2) Keylock Power—the ability to lock the entire system with a key.
3) Theft Protection—the ability to anchor the system to its physical position with a chain or some other means.
4) Access Protection—a means of keeping unauthorized people from using the system even after getting the equipment powered up.
5) Peripheral Security—protection for the printer, disks, monitors and so on, in addition to the computer and its memory.
6) Surge Suppression—electrical protection for the system during operation against abnormal surges of voltage or current in the electrical power to the computer.
7) Power Outlets—convenient outlets for plugging peripherals into a central switching location.
8) Fan System—a fan for cooling the chips and other circuitry components during operation of the computer system.
9) Construction—a measure of the ruggedness and safety of the actual construction of the unit.
10) Styling and Color—the appearance of the unit in the context of existing interior decor.

Example 1. List of criteria.

Listing 1. Decision Aid Program.

```
10  REM  ========================
20  REM    DECISION AID PROGRAM
30  REM    BY ROBERT J. BELANGER
40  REM     COPYRIGHT (C) 1983
50  REM  ========================
60  REM  THIS PROGRAM IS A TOOL FOR ANALYZING
70  REM  DECISIONS. IT CREATES A SORTED LISTING
80  REM  OF TOTAL WEIGHTED SCORES FOR EACH OPTION
90  REM  BEING EVALUATED. THIS LIST SHOWS THE
100  REM  OPTIONS IN DECREASING ORDER OF PREFERENCE.
110  REM  ========================
120  REM   CONSTANTS AND VARIABLES
130  REM  ========================
140 MO = 10: REM  MAX. NO. OF OPTIONS
150 MC = 10: REM  MAX. NO. OF CRITERIA
160 NO = 0: REM  NUMBER OF OPTIONS USED
```

More →

```
E V A L U A T I O N   R E P O R T
================================
APPLE COMPUTER SECURITY
SECURITY SYSTEMS
================================
    O P T I O N S   SCORE
 - ---------------  -----
 0 SYSTEM A.......   538
 1 SYSTEM B.......   520
 2 SYSTEM C.......   368
 3 SYSTEM D.......   367
 4 SYSTEM E.......   316
 5 SYSTEM F.......   309
 6 SYSTEM G.......   299
 7 SYSTEM H.......   277
 8 SYSTEM I.......   262
                  O P T I O N
C R I T E R I A  0 1 2 3 4 5 6 7 8 9 WT
---------------  ------------------ --
PURCHASE PRICE.  8 4 9 3 7 8 6 8 3   9
KEYLOCK POWER..  9 9 9 1 1 1 1 1 1   8
THEFT PROTECT..  9 9 1 9 9 9 9 9 9   8
ACCESS PROTECT.  9 9 1 9 1 1 1 1 1   8
PERIPH SECURITY  8 7 1 9 7 5 6 1 7   8
SURGE SUPPRESS.  9 9 5 1 1 1 1 1 1   7
POWER OUTLETS..  8 8 9 5 5 5 5 5 5   5
FAN SYSTEM.....  7 9 5 5 1 1 1 1 1   4
CONSTRUCTION...  5 7 9 6 7 7 7 7 5   9
STYLING COLOR..  5 5 5 5 5 5 5 5 5   2
```

Example 3. Printout of the evaluation report.

Listing continued.

```
170 NC = 0: REM  NUMBER OF CRITERIA USED
180 T1 = 0: REM  SORTING VARIABLE
190 T3 = 0: REM  SORTING VARIABLE
200 LI = 0: REM  SCREEN LINE NO.
210 P$ = " ": REM  PRINTER SLOT SELECT
220 IN$ = " ": REM  INPUT CHARACTER
230 R$ = " ": REM  REPLY CHARACTER
240 FI$ = " ": REM  FINISHED WITH STUDY
250 SO$ = " ": REM  SORT CONDITION
260 T2$ = " ": REM  SORTING VARIABLE
270  DIM CR$(MC): REM  NAMES OF CRITERIA
280  DIM OP$(MO): REM  NAMES OF OPTIONS
290  DIM TS(MO): REM  TOTAL SCORES
300  DIM SC(MO,MC): REM  SCORES
310  DIM WT(MC): REM  WEIGHTS FOR CRITERIA
320  DIM TI$(2): REM  TITLES
330  DIM KY(MO): REM  SORTING KEY
340  DIM ST$(MO): REM  SORTING STAR
350  DIM NS(MO,MC): REM  NEW SCORE ARRAY
360  REM  ======================
370  REM
380  REM      MAIN ROUTINE
390  REM
400  REM  ======================
410  REM  REPEAT
420  GOSUB 780: REM  BANNER
430  GOSUB 900: REM  INTRODUCTION TEXT
440  GOSUB 1170: REM  GET TITLE INFO
450  GOSUB 1440: REM  GET OPTIONS
460  GOSUB 1750: REM  GET CRITERIA
470  GOSUB 2060: REM  GET WEIGHTS
480  GOSUB 2460: REM  GET SCORES
490  GOSUB 2890: REM  COMPUTE TOTAL SCORES
500  GOSUB 3170: REM  SORT TOTALS
510  GOSUB 4510: REM    TERMINATION
520  IF FI$ = "FALSE" THEN  GOTO 410
530  HOME
540  HTAB 1: VTAB 12
550  PRINT "NORMAL TERMINATION OF DECISION AID ..."
560  PRINT "GOODBYE FOR NOW!"
570  HTAB 1: VTAB 24
580  END
590  REM  ========================
600  REM  SUBROUTINE TO CHECK DATA
610  REM  ========================
620  HTAB 1: VTAB 24
630  PRINT "IS THIS SCREEN OK? (Y/N) ";
640  GET R$
650  IF (R$ <  > "Y") AND (R$ <  > "N") THEN  PRINT  CHR$ (7);: GOTO
620
660  HOME
670  REM  ========================
680  REM  SUBROUTINE PRINTING SLOT
690  REM  ========================
700  IF P$ = "P" THEN  PR# 1: GOTO 720
710  IF P$ = "S" THEN  PR# 0
720  RETURN
730  REM  ========================
740  REM  SUBROUTINE REPORT FORMAT
750  REM  ========================
760  IF P$ = "P" THEN  PRINT : PRINT "           ";: RETURN
770  IF P$ = "S" THEN  RETURN
780  REM  ========================
790  REM    SUBROUTINE BANNER
800  REM  ========================
810  HOME
820  INVERSE
830  PRINT "****************************************"
840  PRINT "*       D E C I S I O N    A I D      *"
850  PRINT "*       BY ROBERT J. BELANGER         *"
860  PRINT "*        COPYRIGHT (C) 1983           *"
870  PRINT "****************************************"
880  NORMAL
890  RETURN
900  REM  ========================
910  REM  SUBROUTINE INTRODUCTION
920  REM  ========================
930  PRINT
940  PRINT "THIS PROGRAM IS A TOOL FOR ANALYZING"
950  PRINT "DECISIONS. A RANKED LIST OF OPTIONS IS "
960  PRINT "CREATED BASED ON YOUR SCORES FOR EACH  "
970  PRINT "OPTION MULTIPLIED BY THE WEIGHTS FOR"
980  PRINT "EACH OF THE CRITERIA."
990  PRINT
1000  PRINT "YOU WILL BE ASKED TO ENTER:"
1010  PRINT "   -TWO TITLE LINES"
1020  PRINT "   -OPTIONS (1-10)"
1030  PRINT "   -CRITERIA (1-10)"
1040  PRINT "   -WEIGHTS FOR THE CRITERIA"
```

More

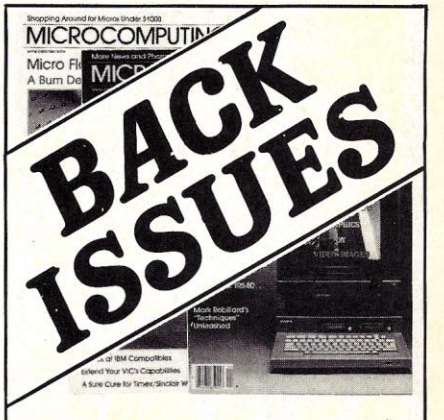
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Listing continued.

```
1050  PRINT "   -SCORES FOR EACH OPTION ON EACH OF  "
1060  PRINT "    THE CRITERIA."
1070  PRINT
1080  PRINT "A REPORT CAN BE PRINTED ON THE SCREEN  "
1090  PRINT "OR PRINTER FOR FUTURE REFERENCE."
1100  VTAB 24
1110  HTAB 1
1120  PRINT "PRESS RETURN TO CONTINUE...";
1130  GET R$
1140  HOME
1150  HOME
1160  RETURN
1170  REM  ========================
1180  REM  SUBROUTINE GET TITLES
1190  REM  ========================
1200  INVERSE
1210  PRINT "**************************************"
1220  PRINT "PLEASE ENTER TWO LINES OF TITLE INFOR- "
1230  PRINT "MATION TO CLEARLY IDENTIFY THE OUTPUT  "
1240  PRINT "PRINTED REPORT (27 CHAR. MAX.).        "
1250  PRINT "EXAMPLE...COMPUTER PRINTER PURCHASE    "
1260  PRINT "          REVISION NO. 1               "
1270  PRINT "**************************************"
1280  NORMAL
1290  FOR I = 1 TO 2
1300  HTAB 1: VTAB 8 + I
1310  PRINT "TITLE NO.";I;" ";
1320  FOR J = 1 TO 28
1330  PRINT ".";
1340  NEXT J
1350  PRINT "              "
1360  HTAB 12: VTAB 8 + I
1370  INPUT IN$
1380 TI$(I) = IN$
1390  IF  LEN (TI$(I)) > 27 THEN  PRINT  CHR$ (7): GOTO 1300
1400  NEXT I
1410  GOSUB 590: REM  DATA CHECK
1420  IF R$ <  > "Y" GOTO 1170
1430  RETURN
1440  REM  ========================
1450  REM  SUBROUTINE GET OPTIONS
1460  REM  ========================
1470  INVERSE
1480  PRINT "**************************************"
1490  PRINT "PLEASE ENTER DESCRIPTIONS FOR EACH     "
1500  PRINT "OPTION BEING CONSIDERED IN THE DECISION"
1510  PRINT "..PRESS RETURN AFTER ENTRY             "
1520  PRINT "..ENTER 'END' TO QUIT ENTRY            "
1530  PRINT "..MAX LENGTH = 15 CHAR.                "
1540  PRINT "..MAX NO. OPTIONS = ";MO;"                "
1550  PRINT "**************************************"
1560  NORMAL
1570  PRINT TI$(1): PRINT TI$(2)
1580  PRINT "======================================="
1590  PRINT " O P T I O N    D E S C R I P T I O N"
1600  PRINT "==============  ======================="
1610 LI = 13:NO = 0
1620  REM :REPEAT
1630 LI = LI + 1:NO = NO + 1
1640  HTAB 7: VTAB LI
1650  PRINT NO: HTAB 17: VTAB LI
1660  PRINT ".....................          ";
1670  HTAB 16: VTAB LI
1680  INPUT IN$:OP$(NO) = IN$
1690  IF  LEN (OP$(NO)) > 15 THEN  PRINT  CHR$ (7): GOTO 1640
1700  IF (OP$(NO) <  > "END") AND (NO <  > MO) GOTO 1620
1710  IF (OP$(NO) = "END") THEN NO = NO - 1
1720  GOSUB 590: REM  DATA CHECK
1730  IF R$ <  > "Y" GOTO 1440
1740  RETURN
1750  REM  ========================
1760  REM  SUBROUTINE GET CRITERIA
1770  REM  ========================
1780  INVERSE
1790  PRINT "**************************************"
1800  PRINT "PLEASE ENTER DESCRIPTIONS FOR THE      "
1810  PRINT "CRITERIA FOR EVALUATING THE OPTIONS.   "
1820  PRINT "..PRESS RETURN AFTER ENTRY             "
1830  PRINT "..ENTER 'END' TO QUIT ENTRY            "
1840  PRINT "..MAX. LENGTH = 15 CHAR.               "
1850  PRINT "..MAX. NO. OF CRITERIA = ";MC;"                "
1860  PRINT "**************************************"
1870  NORMAL
1880  PRINT TI$(1): PRINT TI$(2)
1890  PRINT "======================================="
1900  PRINT "C R I T E R I A  D E S C R I P T I O N "
1910  PRINT "==============  ======================="
1920 LI = 13:NC = 0
1930  REM  REPEAT
1940 LI = LI + 1:NC = NC + 1
1950  HTAB 8: VTAB LI
1960  PRINT NC: HTAB 18: VTAB LI
1970  PRINT ".....................          ";
1980  HTAB 17: VTAB LI
1990  INPUT IN$:CR$(NC) = IN$
2000  IF  LEN (CR$(NC)) > 15 THEN  PRINT  CHR$ (7): GOTO 1950
2010  IF (CR$(NC) <  > "END") AND (NC <  > MC) GOTO 1930
2020  IF (CR$(NC) = "END") THEN NC = NC - 1
2030  GOSUB 590: REM  DATA CHECK
2040  IF R$ <  > "Y" GOTO 1750
2050  RETURN
2060  REM  ========================
2070  REM  SUBROUTINE GET WEIGHTS
2080  REM  ========================
2090  HOME
2100  INVERSE
2110  PRINT "**************************************"
2120  PRINT "PLEASE ENTER WEIGHTS FOR THE CRITERIA: "
2130  PRINT "EXTREMELY       AVERAGE       EXTREMELY "
2140  PRINT "UNIMPORTANT    IMPORTANCE    IMPORTANT "
2150  PRINT "  --- --- --- --- --- --- --- --- ---   "
2160  PRINT "   1   2   3   4   5   6   7   8   9    "
2170  PRINT "  --- --- --- --- --- --- --- --- ---   "
2180  PRINT "**************************************"
2190  NORMAL
2200  PRINT TI$(1): PRINT TI$(2)
2210  PRINT "======================================="
2220  PRINT "C R I T E R I A      W E I G H T       "
2230  PRINT "=======================================": PRINT
2240 LI = 13:
2250  FOR I = 1 TO NC
2260  HTAB 1: VTAB LI + I
2270  PRINT CR$(I)
2280  HTAB 27: VTAB LI + I
2290  PRINT "."
2300  NEXT I
```

More →

Listing continued.

```
2310 LI = 13
2320  FOR I = 1 TO NC
2330  REM  REPEAT
2340  HTAB 27: VTAB LI + I
2350  PRINT "     "
2360  HTAB 27: VTAB LI + I
2370 WT(I) = 0
2380  GET R$: PRINT R$;
2390  IF ( ASC (R$) <  = 48) OR ( ASC (R$) >  = 58) THEN  PRINT
 CHR$ (7)
2400  IF ( ASC (R$) < 49) OR ( ASC (R$) > 57) THEN  GOTO 2330
2410 WT(I) =  ASC (R$) - 48
2420  NEXT I
2430  GOSUB 590: REM  DATA CHECK
2440  IF R$ <  > "Y" GOTO 2060
2450  RETURN
2460  REM  ========================
2470  REM   SUBROUTINE GET SCORES
2480  REM  ========================
2490  FOR I = 1 TO NO
2500  HOME
2510  INVERSE
2520  PRINT "**************************************"
2530  PRINT "PLEASE ENTER SCORES FOR EACH OPTION:   "
2540  PRINT "EXTREMELY        AVERAGE       EXTREMELY "
2550  PRINT "  POOR                          GOOD    "
2560  PRINT "  --- --- --- --- --- --- --- --- ---   "
2570  PRINT "   1   2   3   4   5   6   7   8   9   "
2580  PRINT "  --- --- --- --- --- --- --- --- ---   "
2590  PRINT "**************************************"
2600  NORMAL
2610  PRINT TI$(1): PRINT TI$(2)
2620  PRINT "================"
2630  NORMAL
2640  PRINT "C R I T E R I A     S C O R E          "
2650  PRINT "================     =========          "
2660  FOR K = 1 TO NC
2670  PRINT CR$(K)
2680  NEXT K
2690  HTAB 21: VTAB 11: PRINT "                ";
2700  INVERSE : HTAB 21: VTAB 11: PRINT OP$(I): NORMAL
2710  FOR J = 1 TO NC
2720  HTAB 25: VTAB 13 + J
2730  PRINT ".";
2740  NEXT J
2750  FOR J = 1 TO NC
2760  REM  REPEAT
2770  HTAB 25: VTAB 13 + J
2780  PRINT "     ";
2790  HTAB 25: VTAB 13 + J
2800  GET R$: PRINT R$;
2810  IF ( ASC (R$) <  = 48) OR ( ASC (R$) >  = 58) THEN  PRINT
 CHR$ (7)
2820  IF ( ASC (R$) < 49) OR ( ASC (R$) > 57) THEN  GOTO 2760
2830 SC(I,J) =  ASC (R$) - 48
2840  NEXT J
2850  GOSUB 590: REM  DATA CHECK
2860  IF R$ <  > "Y" GOTO 2500
2870  NEXT I
2880  RETURN
2890  REM  ========================
2900  REM  SUBROUTINE COMPUTE TOTAL
2910  REM  ========================
2920  INVERSE
2930  PRINT "**************************************"
2940  PRINT "C O M P U T E   T O T A L   S C O R E S"
2950  PRINT "**************************************"
2960  NORMAL
2970  PRINT TI$(1): PRINT TI$(2)
2980  PRINT "========================================": PRINT
2990  PRINT "OPTION DESCRIPTION     TOTAL SCORE
3000  PRINT "------------------     -----------"
3010  FOR I = 1 TO NO
3020  PRINT OP$(I)
3030  NEXT I
3040  FOR I = 1 TO NO
3050  HTAB 27: VTAB 9 + I
3060 TS(I) = 0
3070  FOR J = 1 TO NC
3080 TS(I) = TS(I) + SC(I,J) * WT(J)
3090  NEXT J
3100  PRINT TS(I)
3110  NEXT I
3120  HTAB 1: VTAB 24
3130  PRINT "PRESS RETURN TO CONTINUE..";
3140  GET R$
3150  HOME
3160  RETURN
3170  REM  ========================
3180  REM  SUBROUTINE SORT TOTALS
3190  REM  ========================
3200  HOME
3210  FOR I = 1 TO NO
3220 KY(I) = I
3230  NEXT I
3240  INVERSE
3250  PRINT "**************************************"
3260  PRINT "    S O R T I N G    O P T I O N S     "
3270  PRINT "**************************************"
3280  NORMAL
3290  PRINT TI$(1): PRINT TI$(2)
3300  PRINT "========================================"
3310  PRINT
3320  PRINT "OPTION DESCRIPTION     TOTAL SCORE       "
3330  PRINT "------------------     -----------       "
3340  FOR I = 1 TO NO
3350 ST$(I) = " "
3360  NEXT I
3370  REM  REPEAT
3380 SO$ = "TRUE"
3390  FOR I = 1 TO NO - 1
3400  IF TS(I) >  = TS(I + 1) GOTO 3530
3410 ST$(I) = " "
3420 ST$(I + 1) = "*"
3430 T1 = TS(I)
3440 T2$ = OP$(I)
3450 T3 = KY(I)
3460 TS(I) = TS(I + 1)
3470 OP$(I) = OP$(I + 1)
3480 KY(I) = KY(I + 1)
3490 TS(I + 1) = T1
3500 OP$(I + 1) = T2$
3510 KY(I + 1) = T3
3520 SO$ = "FALSE"
3530  IF (SO$ = "TRUE") AND (I <  > 1) THEN  GOTO 3680
```

More

Listing continued.

```
3540 LI = 10
3550  FOR J = 1 TO NO
3560  HTAB 2: VTAB LI + J
3570  PRINT "                    "
3580  HTAB 2: VTAB LI + J
3590  PRINT OP$(J)
3600  HTAB 1: VTAB LI + J
3610  PRINT ST$(J);
3620 ST$(J) = " "
3630  HTAB 25: VTAB LI + J
3640  PRINT "                "
3650  HTAB 27: VTAB LI + J
3660  PRINT TS(J);
3670  NEXT J
3680  REM  CONTINUE
3690  NEXT I
3700  IF SO$ = "FALSE" THEN  GOTO 3370
3710  HTAB 1: VTAB 23
3720  PRINT "OPTIONS ARE SORTED"
3730  PRINT "PRESS RETURN TO CONTINUE..";
3740  GET R$: PRINT R$;
3750  HOME
3760  RETURN
3770  REM  ========================
3780  REM  SUBROUTINE  PRINT REPORT
3790  REM  ========================
3800  HOME
3810  PR# 0
3820  VTAB 4: HTAB 1
3830  GOSUB 670: GOSUB 730: REM  PRINT FORMAT
3840  PRINT "E V A L U A T I O N   R E P O R T"
3850  GOSUB 730: REM  FORMAT
3860  PRINT "================================="
3870  GOSUB 730
3880  PRINT TI$(1)
3890  GOSUB 730
3900  PRINT TI$(2)
3910  GOSUB 730
3920  PRINT "================================="
3930  GOSUB 730
3940  PRINT "    O P T I O N S   SCORE"
3950  GOSUB 730
3960  PRINT " - ---------------  -----"
3970  GOSUB 730
3980  FOR I = 1 TO NO
3990  PRINT " ";I - 1;" ";OP$(I);
4000  IF  LEN (OP$(I)) = 15 GOTO 4040
4010  FOR J = 1 TO (15 -  LEN (OP$(I)))
4020  PRINT ".";
4030  NEXT J
4040  PRINT "   ";
4050  PRINT TS(I);
4060  PRINT " "
4070  GOSUB 730: REM  REPORT FORMAT
4080  NEXT I
4090  HTAB 1: VTAB 24
4100  IF P$ = "P" GOTO 4140
4110  PR# 0
4120  PRINT "PRESS RETURN TO CONTINUE..";
4130  GET R$: PRINT R$
4140  HOME
4150  PR# 0
4160  VTAB 4: HTAB 1
4170  PRINT "E V A L U A T I O N   R E P O R T"
4180  PRINT "================================="
4190  PRINT TI$(1): PRINT TI$(2)
4200  PRINT "================================="
4210  GOSUB 670
4220  PRINT "                        O P T I O N       "
4230  GOSUB 730: REM  REPORT FORMAT
4240  PRINT "C R I T E R I A  0 1 2 3 4 5 6 7 8 9 WT"
4250  GOSUB 730
4260  PRINT "---------------  -------------------- --"
4270  GOSUB 730
4280  FOR J = 1 TO NC
4290  PRINT CR$(J);: IF  LEN (CR$(J)) = 15 GOTO 4330
4300  FOR I = 1 TO (15 -  LEN (CR$(J)))
4310  PRINT ".";
4320  NEXT I
4330  PRINT "  ";
4340  FOR I = 1 TO NO
4350  PRINT NS(I,J);" ";
4360  NEXT I
4370  IF NO = 10 THEN  PRINT " ";: GOTO 4420
4380  FOR I = 1 TO (10 - NO)
4390  PRINT "  ";
4400  NEXT I
4410  PRINT " ";
4420  PRINT WT(J)
4430  GOSUB 730
4440  NEXT J: PRINT : PRINT : PRINT : PRINT
4450  PR# 0
4460  HTAB 1: VTAB 24
4470  PRINT "PRESS RETURN TO CONTINUE..";
4480  GET R$: PRINT R$
4490  HOME
4500  RETURN
4510  REM  ========================"
4520  REM  SUBROUTINE TERMINATION
4530  REM  ========================"
4540 FI$ = "TRUE"
4550  HTAB 1: VTAB 12
4560  PRINT "DO YOU WANT TO PRINT A REPORT? (Y/N) ";
4570  FOR I = 1 TO NO
4580  FOR J = 1 TO NC
4590 NS(I,J) = SC(KY(I),J)
4600  NEXT J
4610  NEXT I
4620  GET R$: PRINT R$;
4630  IF R$ <  > "Y" THEN  GOTO 4730
4640  REM  REPEAT
4650  HTAB 1: VTAB 12
4660  PRINT "                                                "
4670  HTAB 1: VTAB 12
4680  PRINT "S)CREEN OR P)RINTER? (S/P) ";
4690  GET P$: PRINT P$
4700  IF (P$ <  > "S") AND (P$ <  > "P") THEN  PRINT  CHR$ (7)
4710  IF (P$ <  > "S") AND (P$ <  > "P") THEN  GOTO 4640
4720  GOSUB 3770: REM  PRINT REPORT
4730  REM  CONTINUE
4740  HTAB 1: VTAB 12
4750  PRINT "                                                "
4760  PRINT "DO YOU HAVE ANOTHER PROBLEM? (Y/N) ";
4770  GET R$: PRINT R$
4780  IF (R$ = "Y") THEN FI$ = "FALSE"
4790  RETURN
4800  REM  ============ END OF DECISION AID ===============
```

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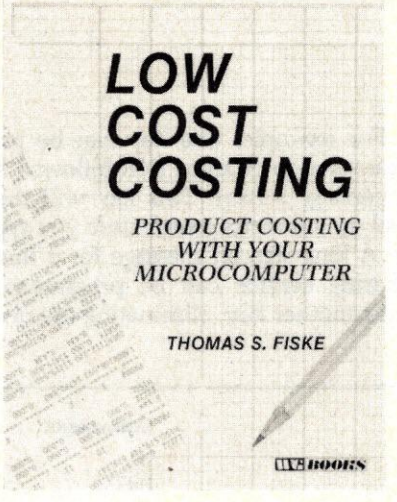
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The Key(s) to Adaptability

This project uses an EEPROM to make your keyboard more adaptable. The EEPROM stores key characters, making permanent changes simple. With this modification, you can produce new keyboard layouts or assign multiple characters to a single key.

By Stuart R. Ball

Here's a keyboard project that uses an EEPROM to store the key characters, making permanent changes simple. You can redefine keys to produce new keyboard layouts or even assign multiple characters to a single key.

For example, one key can be programmed to produce DIR followed by a carriage return. This key will then call up a directory each time you type it. A long sign-on message for a time-sharing service can be programmed into another key, eliminating the need to type the entire message when signing on.

Since the changes are made at the keyboard, it's not necessary to load new software into the computer each time it's used. Since the changes are stored in EEPROM, they are permanent.

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1	74LS374	U5
1	74LS04	U6
1	74LS32	U7
1	74LS74	U8
1	74LS00	U9
2	74LS138	U10, U11
1	4 MHz crystal	
10	6.8 k ¼ W resistors	
1	10 k ¼ W resistor	
2	33 k ¼ W resistors	
3	3.9 k ¼ W resistors	
1	150 k ¼ W resistor	
17	1N4454 or 1N914 or 1N4148 diodes	
1	15 μF 10V capacitor	
4	.1 μF 15V ceramic capacitors	Bypass
1	2N2222 transistor	
1	SPST normally open, momentary switch.	Learn key
1	SPST or SPDT toggle or slide switch.	Learn inhibit (S1)

misc: wire, IC sockets, perfboard, surplus keyboard

Note: All of the parts for this circuit (except the keyboard) are available from: Barton Digital, 999 44th St., Marion, IA 52302. Request price list 30725-01.

Table 1. Parts lists—EEPROM keyboard.

About the Circuit

The keyboard uses an 8085 microprocessor, an 8156 PIA, a 5V EEPROM and some miscellaneous circuitry (see Table 1). I chose the 8085/8156 combination because the parts are readily available (mine were just laying around, in fact) and, more importantly, because I had an assembler for the 8085.

The heart of the circuit is the EEPROM, which contains the keyboard program and the keyboard character tables. The EEPROM is modified by the software whenever a key is changed and, since it's nonvolatile, the changes remain when the power is turned off. The EEPROM I used is a XICOR X2816, but other 5V-only EEPROMs work as well. The SEEQ 52B13 has been tried and seems to work. A 21V EEPROM can be used, but the circuit has to be modified to add a 21V supply and write circuitry.

The keyboard itself is a surplus unit that I purchased for about $15. It's a mechanical keyboard, but a Hall-effect or capacitive unit can be used

with appropriate circuit modifications. I added two extra switches to the keyboard. The learn key causes the keyboard to enter and leave the learn mode. This switch should be located far enough away from the normal keys to prevent accidental activation.

The second switch, called learn inhibit, performs two functions. It protects the EEPROM from changes if the learn mode is accidentally activated, and it also protects the EEPROM from changes caused by power up/power down. This two-switch protection is especially useful if small children or careless adults have access to the keyboard.

I added two LEDs to the keyboard, one to indicate the learn mode and one to indicate the alpha lock.

The keys (except for the shift, learn and control keys) are wired into a 16 by 4 matrix (see Fig. 1). Pressing any key shorts the wires connecting it together. The processor writes the 16 columns one at a time and reads the four rows to see if any key is pressed. The shift, learn and control keys are connected so that they can be read individually and used simultaneously with the keys in the matrix.

FlipFlops

The output connector isn't shown on the schematic (see Fig. 1), because its type depends on the system that you use with the keyboard. The power supply isn't shown for the same reason. The keyboard needs +5V, which should be available from the existing computer system.

Referring to the schematic, the D flipflop in the ready logic does two things. First, it causes any write to the EEPROM to be extended to 10 milliseconds (ms). The flipflop also causes the first instruction after the write to be extended to 10 ms. This is because some EEPROMS need a 10-ms write pulse, and others need 10 ms after the write pulse to perform the write operation. The 10-ms write time may be modified by changing (in the software) the 8156 count length, which determines the wait time. The software also has a provision for a software timing loop to provide a post-write delay for EEPROMS that need one. (Some EEPROMs cannot be accessed for several microseconds after a write.)

The chip select on the EEPROM is gated with the processor read and write lines. The usual connection is just to address decode logic. Some EE-

Listing 1. Program to reprogram the EEPROM and control the keyboard.

```
        ; REV 7/25/83
        ; AUTHOR: S. BALL

        ; THIS IS THE CODE FOR THE EEPROM CONFIGURABLE KEYBOARD.
        ;
        ; PROGRAM EQUATES
        ;
        ; I/O PORTS
CMDPRT  EQU 60H     ; 8156 COMMAND/STATUS PORT
PAPORT  EQU 61H     ; 8156 PORT A
PBPORT  EQU 62H     ; 8156 PORT B
PCPORT  EQU 63H     ; 8156 PORT C
TIMRLO  EQU 64H     ; LOW 8 BITS OF 8156 TIMER
TIMRHI  EQU 65H     ; HI 6 BITS OF TIMER, TIMER MODE
DATA    EQU 00      ; OUTPUT DATA LATCH
                    ;
                    ; RAM EQUATES
ROW     EQU 3000H   ; ROW INPUT BITS
COLUMN  EQU 3001H   ; CURRENT KEYBOARD COLUMN TO BE SCANNED
POINT   EQU 3002H   ; (WORD). POINTER TO LOCATION IN EEPROM TO
                    ; BE WRITTEN BY WRPROM ROUTINE.
BUFFER  EQU 3004H   ; HOLDS CHARACTER TO BE OUTPUT
SHIFT   EQU 3005H   ; SET TO ONE IF SHIFT KEY IS PRESSED
LEARN   EQU 3006H   ; SET TO ONE IF KEYBOARD IS IN LEARN MODE
LRNCNT  EQU 3007H   ; COUNT OF CHARACTERS LEARNED FOR CURRENT
                    ; LEARN KEY.
CNTL    EQU 3008H   ; SET TO ONE IF CNTL KEY IS PRESSED.
CAPLOC  EQU 3009H   ; SET TO ONE IF FOR ALPHA LOCK
LASLRN  EQU 300AH   ; LAST VALUE OF LEARN KEY.  USED TO DETERMINE
                    ; WHETHER OR NOT LAST LEARN KEYPRESS HAS BEEN
                    ; SERVICED.
MASK    EQU 300BH   ; ROW MASK.  USED TO DETERMINE WHEN KEY HAS BEEN
                    ; RELEASED.
LRNADR  EQU 300CH   ;(WORD) ADDRESS IN KEYTABLE OF CURRENT KEY TO LEARN.
TEMP    EQU 300EH   ; STORAGE FOR TRANSMITTED CHARACTER
STACK   EQU 30FFH   ; TOP OF STACK
                    ;
                    ; PROGRAM CONSTANTS
                    ;
REPEAT  EQU 2000    ; REPEAT LOOP COUNTER - SETS REPEAT RATE.
WAIT    EQU 04000H  ; DELAY CONSTANT BEFORE REPEAT STARTS
LOCKEY  EQU 38H     ; ALPHA LOCK ADDR IN KEYTABLE
RSTKEY  EQU 0       ; RESET ALPHA LOCK ADDR IN KEYTABLE.
CTLMSK  EQU 20H     ; AND MASK FOR CONTROL KEY.
SHMSK   EQU 10H     ; AND MASK FOR SHIFT KEY.
LRNMSK  EQU 40H
WRDLY   EQU 1800    ; DELAY FOR DEBOUNCE INTERVAL.
                    ;
                    ; INIT PROCESSING
                    ;
        ORG 0800H   ; PROGRAM STARTS AT 800, BECAUSE THE CP/M
                    ; LOADER DOES NOT LIKE ADDRESSES BELOW 100H.
                    ;
        JMP INIT    ; JUMP TO INIT BECAUSE PROCESSOR STARTS AT
                    ; 0, BUT PROGRAM STARTS AT 800H.
INIT    LXI SP,STACK
        MVI A,0
        STA SHIFT   ; CLEAR SHIFT, LEARN, CONTROL FLAGS
        STA CNTL
        STA LEARN
        MVI A,1     ; DEFAULT ALPHA LOCK= ON.
        STA CAPLOC
                    ;
                    ; SET UP PIA:
                    ; PA = OUT, PB= INPUT, PC=OUT, TIMER OFF.
        MVI A,04DH  ; SETUP VALUE
        OUT CMDPRT
        MVI A,80H   ; RESET DATA STROBE TO LOW
        OUT DATA
                    ;
                    ; SCAN SCANS THE KEYBOARD FOR A KEYPRESS, AND
                    ; CHECKS THE SPECIAL FUNCTION KEYS.
SCAN    MVI A,0     ; INITIAL COLUMN = 0.
        STA COLUMN
SCANLP  LDA COLUMN  ; CURRENT COLUMN TO SCAN.
        CPI 16      ; IF COLUMN ROLLED OVER FROM 15 TO 16, THEN IT
        JZ LASCOL   ; IS TIME TO CHECK THE SPECIAL FUNCTION KEYS.
        MOV B,A     ; SAVE COLUMN
        LDA CAPLOC  ; SEE IF ALPHA LOCK MODE.
        CPI 0       ; 0 = NO ALPHA LOCK, 1 = ALPHA LOCK.
        JZ NOLOCK   ; NOT LOCKED, GO CHECK LEARN MODE
        MOV A,B     ; GET COLUMN NUMBER.
        ORI 80H     ; OR IN MSB TO LIGHT ALPHA LOCK LED.
        MOV B,A     ; PUT COLUMN NUMBER BACK IN B.
NOLOCK  LDA LEARN   ; SEE IF IN LEARN MODE
        CPI 0
        JZ NOLRN    ; 0 = NOT LEARN MODE.
        MOV A,B     ; GET COLUMN NUMBER
        ORI 40H     ; OR IN BIT 6 TO LIGHT LEARN LED.
        MOV B,A     ; SAVE MODIFIED COLUMN NUMBER.
```

(Continued on p. 107)

PROMs, however, latch the addresses on the falling edge of chip select. Gating chip select with the processor control lines guarantees that the addresses will be stable when chip select falls. This reduces the time that the processor has to access the EEPROM, but in this circuit, the 8085 only runs at 2 MHz, so the slow 450- or 500-nanosecond parts may be used.

The 8156 has enough unused pins to use a larger keyboard, if desired. Another 16 keys may be added just by using another row.

About the Software

The software performs two functions. First, it scans the rows and columns looking for keys that have been pressed. These keys are fetched from a table of ASCII characters and sent to the output port.

> Obviously, if keys are constantly reassigned, the string table will eventually fill up with inaccessible entries. When the table is full, the keyboard will refuse to learn any new keys.

The software's second function is to "teach" the keyboard. In the learn mode, the key being modified is replaced with the first key you type. If more than one key is typed, the replacement becomes a multicharacter string and is placed into a separate table in the EEPROM (the string table).

Since all ASCII characters can be represented with only seven bits, the most significant bit (MSB) is used as a flag bit. The flag bit has one of two meanings, depending on the table in which it occurs. If the MSB is set for a key in the normal table (one character per key), it indicates that the key has been assigned to a multicharacter string. The least significant seven bits of the entry indicate the table entry number in the string table. If the MSB is set for an entry in the multicharacter string table, it indicates the last entry for that string.

For example, if the key PA1 is assigned to the character Control-D, then Control-D replaces PA1 in the normal key table. If the key PA2 is assigned to the string DIR followed by a carriage return, and that key is the fourth multicharacter key assigned, then the entry in the normal table for the PA2 key becomes 84 (hex). The MSB is set, and the least significant seven bits indicate that the string is the fourth entry in the table. The software finds the end of the third entry in the string table and follows it with the characters DIR, followed by a carriage return with its MSB set to one (8D hex). When PA2 is typed, the fourth entry in the string table is located and sent to the data port, up to and including the carriage return.

Stringing Along

Structuring the string table this way allows strings to be any length, up to the length of the table. This approach also causes one problem: If the total length of the string table exceeds the available space, no new characters can be assigned in the table. There are two solutions to this problem. One is to rewrite the table, when strings are deleted, to make room for new ones. The second solution is to continue appending new strings to the end of the used space until no space is left, and then provide some means to erase the string table. The first method will take up to about 30 seconds each time a key is defined to a string value more

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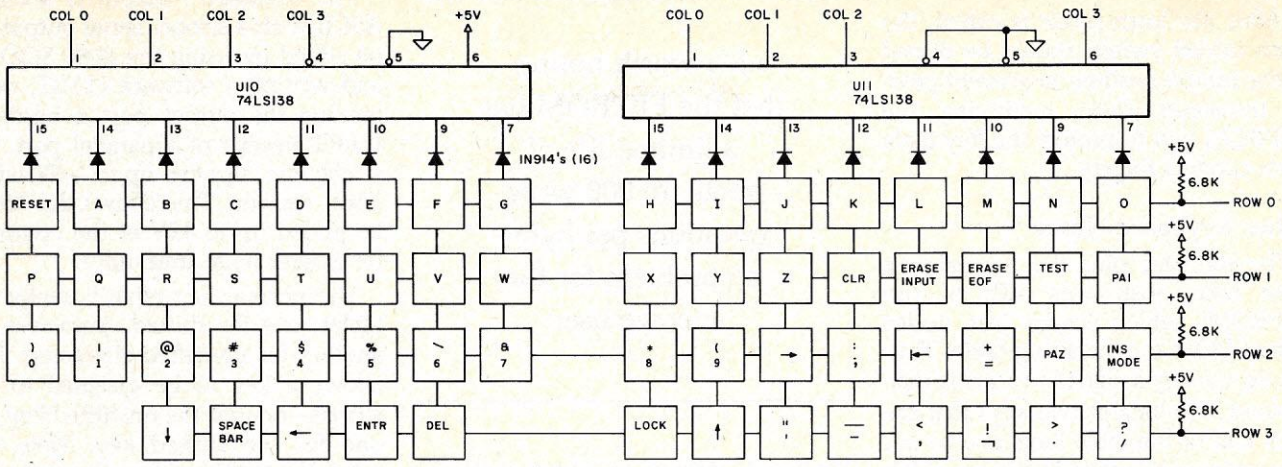


Fig. 1. EEPROM keyboard key matrix.

than once. The second method requires rewriting the entire string table when it becomes full.

I chose the second method for this design to avoid waiting for the table to be rewritten. What this means is that if a key is assigned to a string that is, say, the fifth entry in the string table, and then the same key is later reassigned to a different string that becomes the sixth entry, the fifth entry is unavailable for use. That fifth entry still exists, but no key can access it.

Obviously, if keys are constantly reassigned, the string table will eventually fill up with inaccessible entries. When the table is full, the keyboard will refuse to learn any new keys. When this happens, your only recourse is to erase the entire table by holding down the learn, shift and control keys simultaneously. When the table is erased, the actual string table is unchanged, but all of the pointers to it in the normal key table are removed. This has the effect of resetting the string table pointer to the beginning of the table, where old string entries can be overwritten.

Assignation

To assign a string to a key, follow this sequence:

1) Switch the learn inhibit switch to the enable position. If the inhibit switch is left in inhibit position, the keyboard attempts to enter the learn mode, but the EEPROM isn't actually modified.

2) Press the learn key and learn LED comes on.

3) The first key you press becomes the key assigned. If learn is pressed again, the learn operation is aborted.

4) The next key pressed replaces the key to learn in the normal key table. If learn is pressed, the key becomes a one-character key and the learn mode is exited.

5) The next key pressed indicates that the key is a multicharacter string, and the first empty entry in the string table is found. The first key entered (step 3) replaces the first location in the string table entry, and the present key becomes the second location.

6) Add any subsequent keys to the string entry.

7) When learn is pressed again, the last string entry location changes so that the MSB equals 1, and the normal table entry is set to the string table entry number with the MSB set to one. Learn mode is then exited. Note that the key to learn doesn't actually become a string entry until learn mode is

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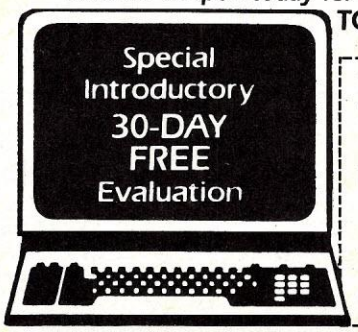
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exited.

8) After the learn mode is exited, the learn inhibit switch should be placed in the inhibit position to prevent power transients from modifying the EEPROM and to protect the key table from careless fingers.

Other Keyboard Notes

The software plus the normal key table takes just over 1Kb of the EEPROM, which leaves just under 1Kb of ROM for the string table. This can be one key assigned to a string that is about 1Kb long or two keys that are each half of the table long, and so on. The limits on the string table are as follows: There can be no more characters in the table than there is space (obviously). There can be no more than 127 entries in the table, since the MSB of the entry number is used as a flag. This doesn't mean 127 keys—the 127 entry limit includes inaccessible entries. If the number of entries reaches 127, the string table must be erased before any more strings can be assigned.

In the learn mode, the software still sends all keys learned to the output port, unless the end of the table is reached. In this case, the keyboard refuses to either learn or echo any characters entered until the learn mode is exited. In addition, if the number of string table entries reaches 127, the keyboard refuses to learn multiple character strings until the string table is erased. It is still possible to learn single keys because these don't affect the length of the string table.

> It's worth noting that the EEPROM has a limited life of about 10,000 write operations per byte—no problem for the average user.

When you write to the EEPROM, there's a dead time of about 10 ms during which it can't be accessed. This means that the software doesn't execute out of the EEPROM while it's writing. For this reason, the routine that writes to the EEPROM and provides the delay is written to memory and executed there. In addition, the time needed to write the EEPROM isn't long, but it's noticeable. For this reason, extremely fast typists must slow down when typing with the keyboard in learn mode.

The keyboard's output is seven-bit ASCII with a strobe. Serial output can be added by using the 8085 SOD pin and writing a software UART, or by making the output port a hardware UART instead of a parallel port. The strobe line is pulled up to +5V with a 33Kb resistor. This allows the line to be pulled up to 12V at the computer for greater noise immunity.

The normal key table is really two tables: one for shifted characters and another for unshifted characters. This allows a key to be assigned to two strings—one for the unshifted key and one for the shifted key. Note that when the keyboard is in the alpha lock mode, learned keys aren't shifted. For example, say that the keyboard is in the alpha lock mode and that the key PA1 is to be assigned to the string DIR. If the shift key isn't held down while typing DIR, the PA1 key is assigned to lowercase dir, not uppercase DIR. However, the characters echoed will be uppercase. This is because the character output routine performs the alpha lock modification independently of the shift key and the learn mode. The learn routines don't check for the alpha lock mode when performing key assignments. The control key is checked by the learn routines so that keys can be assigned to control functions.

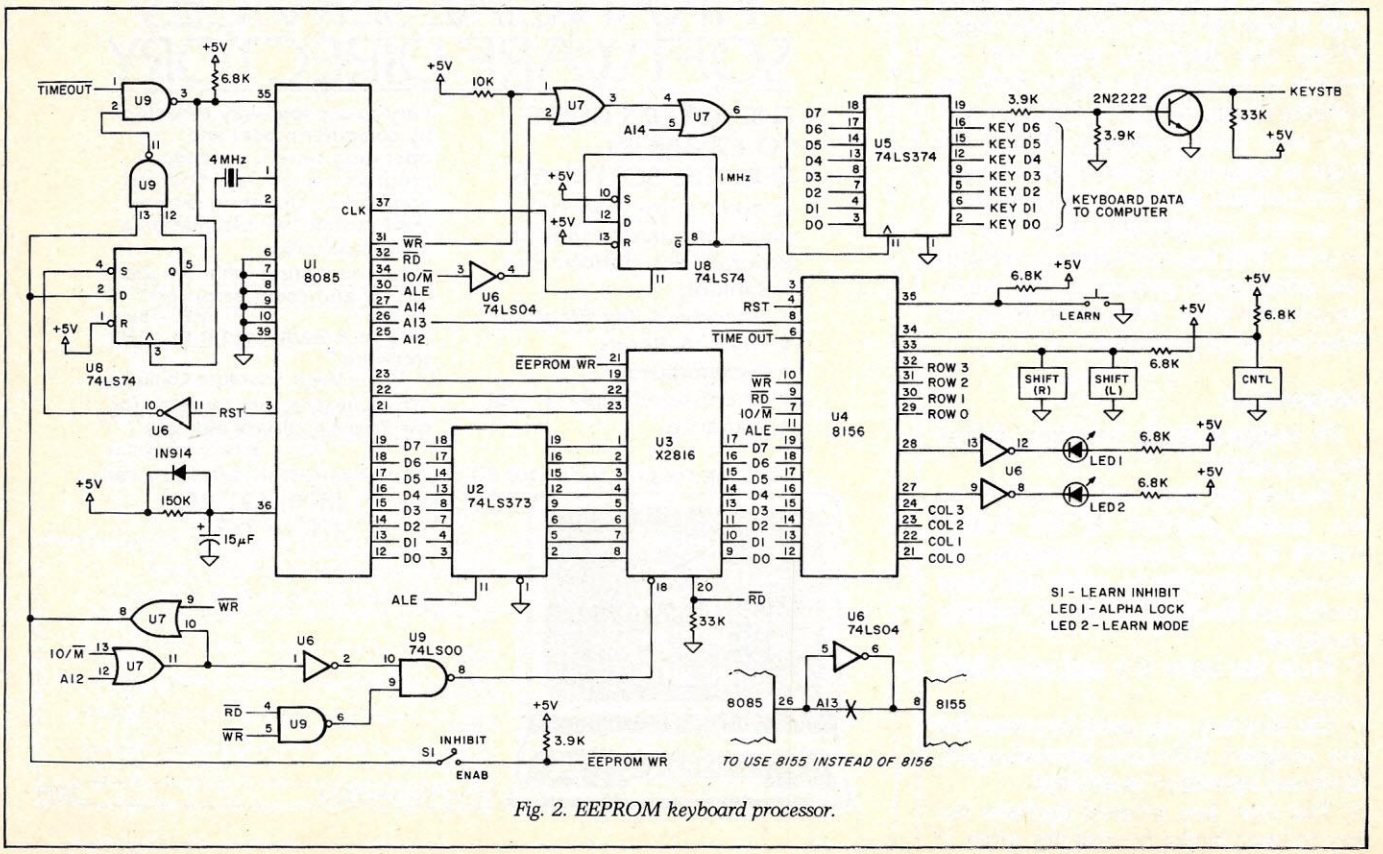


Fig. 2. EEPROM keyboard processor.

The key tables shown are for the keyboard that is used in the original circuit. Obviously, the layout for all keyboards isn't the same, so the tables shown change for different keyboards. The table layout is by the keyboard columns. The first entry in the table is row 0, column 0, the second entry is row 0, column 1, and so on.

Using the Keyboard

When not in learn mode, the keyboard operates much like any other keyboard does. Whatever is typed is sent to the output port, and any key that's held down for more than three tenths of a second repeats at a rate of about 5 Hz. The lock key causes the keyboard to enter the alpha lock mode, which forces characters from a to z to always be uppercase. The reset key resets the alpha lock mode. Any multiple character string key prints the entire string when typed.

The keyboard is placed in the learn mode when the learn key is pressed. The first key entered after the learn key should be the key to be learned (i.e., the key that will be changed). Any subsequent keys are assigned to the key to learn. This continues until the learn key is pressed again or you reach the end of the string table. (This all assumes that the learn-inhibit switch is in the enable position.) Keys typed while in the learn mode are echoed but not repeated. The first key after the learn key (the key to learn) isn't echoed.

New key layouts (such as the Dvorak keyboard) can be permanently programmed. If you swap keys around, it's necessary to assign one key as a temporary key to hold intermediate values. For example, to swap the A and B keys, assign the PA1 key to A; assign A to B and then assign B to PA1.

If the string table is full (which it is when the keyboard refuses to echo keys while in the learn mode), you can erase by holding down the shift, control and learn keys simultaneously.

It's worth noting that the EEPROM has a limited life of about 10,000 write operations per byte. The EEPROM should hold the data programmed into it for about ten years—no problem for the average user. 10,000 writes in ten years is about three changes per day, per address.■

Address correspondence to Stuart R. Ball, 1101 Dover St. NE, Cedar Rapids, IA 52402.

Listing continued.

```
NOLRN   MOV A,B         ; B NOW CONTAINS THE COLUMN NUMBER, WITH THE
                        ; MSB SET IF IN ALPHA LOCK MODE, AND BIT 6
                        ; SET IF IN LEARN MODE.
        OUT PAPORT      ; OUTPUT COLUMN, LED BITS.
        ANI 0FH         ; STRIP OFF LED BITS
        INR A           ; INCR TO NEXT COLUMN.
        STA COLUMN      ; SAVE FOR NEXT SCAN
        IN PBPORT       ; READ ROW BITS
        CMA             ; INVERT BITS, BECAUSE A KEYPRESS CAUSES A 0
                        ; TO OCCUR IN THE CORRESPONDING BIT, AND A
                        ; 1 IS EASIER TO WORK WITH.
        ANI 0FH         ; ONLY 4 ROWS.
        STA ROW         ; SAVE ROW BITS
                        ;
                        ; A ONE IS NOW SET IN (ROW) FOR EACH ROW FOR
                        ; WHICH A KEY IS PRESSED IN THE CURRENT COLUMN.
                        ; AS A RESULT OF THE AND OPERATION, THE ZERO
                        ; FLAG IS SET IF NO KEY IS DOWN, AND RESET IF
                        ; A KEY IS DOWN.
        JNZ KYDOWN      ; GO IF A KEYPRESS OCCURED
        JMP SCANLP      ; NO KEYPRESS, GO SCAN NEXT COLUMN.
LASCOL  IN PBPORT       ; GET SPECIAL KEYS
        CMA
        ANI SHMASK      ; SHIFT KEY MASK
        JZ SFTNOT
        MVI A,1         ; SHIFT DOWN, SET SHIFT MODE
SFTNOT  STA SHIFT       ; SET SHIFT TO 1 IF SHIFT WAS DOWN, 0 IF NOT
        IN PBPORT       ; NOW CHECK CONTROL KEY.
        CMA
        ANI CTLMSK
        JZ CTLNOT
        MVI A,1         ; SET A=1 IF CTL IS PRESSED
CTLNOT  STA CNTL        ; SET CONTROL FLAG
        MVI A,0         ; ZERO COLUMN NUMBER FOR NEXT SCAN
        STA COLUMN
        IN PBPORT       ; LEARN KEY
        CMA
        ANI LRNMSK
        JNZ XLEARN      ; GO IF LEARN MODE
        STA LASLRN      ; STORE 0 IN LAST LEARN VALUE
        JMP SCANLP      ; GO SCAN ANOTHER ROW
                        ;
                        ; XLEARN SERVICES LEARN KEYPRESS.  IF ALREADY
                        ; SERVICED, RETURNS.  IF ALREADY IN LEARN MODE,
                        ; RESETS TO NORMAL MODE.  IF NOT ALREADY IN
                        ; LEARN MODE, SETS LEARN MODE.
                        ;
XLEARN  CALL DEBOUN     ; DEBOUNCE LEARN KEYPRESS
        IN PBPORT       ; SEE IF KEY STILL DOWN
        CMA
        ANI LRNMSK
        JZ SCANLP       ; KEY NOT STILL DOWN, MUST HAVE BEEN A KEY
                        ; RELEASE INSTEAD OF A KEY PRESS.
        IN PBPORT
        ANI 70H         ; SEE IF LEARN, SHIFT, AND CONTROL ALL DOWN.
        JZ ERASE        ; IF ALL PRESSED, GO ERASE LEARNED KEY TABLE.
        LDA LASLRN      ; SEE WHAT LAST VALUE OF LEARN KEY WAS
        CPI 0           ; IF LAST VALUE WAS NOT 0, THEN LEARN KEYPRESS
                        ; HAS ALREADY BEEN SERVICED.
        JNZ SCANLP
        MVI A,1         ; SET SERVICE FLAG, AND SERVICE LEARN KEYPRESS.
        STA LASLRN
        LDA LEARN       ; IF ALREADY IN LEARN, RESET LEARN MODE.
        CPI 0
        JNZ RSTLRN      ; ALREADY IN LEARN, GO RESET MODE.
        MVI A,1         ; SET LEARN MODE
        STA LEARN
        MVI A,0
        STA LRNCNT      ; SET COUNT OF LEARN CHARS RECEIVED TO 0.
                        ;
                        ; THE NEXT SECTION OF CODE WILL FIND THE
                        ; FIRST EMPTY ENTRY IN THE MULTI CHARACTER
                        ; TABLE.  THIS ENTRY MAY NOT BE USED.  SPECIFICALLY,
                        ; THE TABLE WILL ONLY BE WRITTEN IF THE NUMBER
                        ; OF KEYS ENTERED TO REPLACE A LEARNED KEY EXCEEDS
                        ; 1.  IF THE NUMBER OF REPLACEMENT KEYS IS 1, THEN
                        ; THE REPLACEMENT WILL FIT IN THE NORMAL KEY TABLE.
                        ;
        LDA LRNNUM      ; NUMBER OF ENTRIES IN MULTI KEY TABLE
        MOV C,A
        LXI H,LRNTAB    ; START OF MULTI KEY TABLE
        CPI 0           ; IF LRNNUM IS 0, THEN HL IS ALREADY
        JZ LRNFO        ; POSITIONED AT FIRST ENTRY
LRNAGN  INX H
        MOV A,M         ; REPLACEMENT CHAR
        ANI 80H         ; SEE IF LAST CHAR IN GROUP
        JZ LRNAGN       ; MSB=0, SO NOT LAST CHAR IN GROUP
                        ; LAST CHAR IN ONE GROUP, SO DECR NUMBER OF ENTRIES.
        DCR C
        JNZ LRNAGN      ; LOOP UNTIL ALL ENTRIES DONE
        INX H           ; HL NOW POINTS TO FIRST EMPTY ENTRY IN MULTI CHAR
                        ; TABLE.
```

More

Listing continued.

```
LRNFO  SHLD POINT  ; SAVE IN POINT FOR LATER USE.
       JMP SCANLP  ; CONTINUE LOOPING.
                   ;
                   ; KEYDOWN CONVERTS THE KEY THAT IS PRESSED. IF
                   ; KEY IS ALPHA LOCK OR ALPHA LOCK RESET, SETS
                   ; OR RESETS ALPHA LOCK MODE AND RETURNS.  IF KEY
                   ; IS MULTI CHAR LEARNED KEY,  PASSES CONTROL TO
                   ; ROUTINE THAT OUTPUTS THE STRING.  IF IN LEARN
                   ; MODE, PASSES CONTROL TO LEARNT ROUTINE TO
                   ; SAVE LEARNED KEY.
                   ; IF NONE OF THE ABOVE CONDITIONS OCCURS, OUTPUTS
                   ; CONVERTED KEY TO DATA PORT.
KYDOWN CALL DEBOUN ; DEBOUNCE KEY
       IN PBPORT
       CMA
       ANI OFH     ; JUST ROW BITS NEEDED.
       MOV B,A     ; SAVE ROW BITS
       LDA ROW
       CMP B       ; IF ROW BITS ARE NOT NOW THE SAME AS THEY WERE
                   ; IN SCAN ROUTINE, THEN KEPRESS WENT AWAY DURING
                   ; DEBOUNCE TIME.
       JNZ SCANLP
                   ;
                   ; VALID KEYPRESS, NOW FIND FIRST ROW BIT THAT IS SET.
       MVI B,0
       MVI C,1
KYAGN  RRC         ; ROTATE ROW BIT 0 INTO CARRY
       JC GOTBIT   ; A ONE OCCURED
       MOV D,A     ; SAVE ROW
       MOV A,C
       RLC         ; ROTATE THE ONE IN C
       MOV C,A
       INR B       ; INCR ROW NUMBER.
       MOV A,D     ; GET SHIFTED ROW BACK INTO A
       JMP KYAGN
                   ;
                   ; AT THIS POINT, C CONTAINS A 1 IN THE BIT POSITION
                   ; FOR WHICH A ONE OCCURED IN THE ROW.  THIS VALUE
                   ; WILL BE USED FOR ANDING WITH THE INPUT DATA FROM
                   ; PORT B TO ISOLATE THE ROW.  B CONTAINS A NUMBER
                   ; FROM 0 TO 3 THAT INDICATES WHICH ROW THE ONE
                   ; OCCURED IN.
GOTBIT MOV A,C
       STA MASK    ; SAVE MASK FOR LATER USE
       MOV A,B     ; GET ROW NUMBER
       STA ROW     ; ROW NOW CONTAINS ROW NUMBER, INSTEAD OF ROW BITS.
                   ;
                   ; NOW THE ROW AND COLUMN NUMBERS WILL BE USED AS
                   ; AN OFFSET INTO THE KEY TABLE TO GET THE CHARACTER
                   ; THAT CORRESPONDS TO THE KEY.  THE LS 4 BITS OF THE
                   ; OFFSET ARE THE COLUMN NUMBER.  BITS 4 AND 5 ARE THE
                   ; ROW NUMBER, AND BIT 6 IS A ONE IF THE SHIFT KEY
                   ; IS PRESSED.

       LDA COLUMN  ; COLUMN NUMBER
       DCR A       ; DECREMENT, BECAUSE IT WAS INCREMENTED TO COLUMN + 1
       ANI OFH     ; IN SCAN ROUTINE.
       MOV C,A
       LDA ROW     ; ROW #.
       RLC
       RLC
       RLC
       RLC         ; ROW BITS ARE NOW BITS 4 AND 5.
       ORA C       ; OR ROW BITS WITH COLUMN BITS
       MOV C;A     ; SAVE NEW BITS
       LDA SHIFT   ; SHIFT / NO SHIFT FLAG.
       CPI 0
       JZ KYNOSH   ; NOT SHIFTED
       MVI A,40H   ; BIT 5 = SHIFT
       ORA C
       MOV C,A
                   ;
                   ; AT THIS POINT, C CONTAINS THE COLUMN NUMBER, THE
                   ; ROW NUMBER, AND BIT 5 SET IF SHIFT.
KYNOSH MVI B,0     ; B=0, C= OFFSET INTO TABLE.
       MOV A,C     ; SEE IF ALPHA LOCK OR ALPHA LOCK RESET.
       ANI 3FH     ; STRIP OFF SHIFT BIT
       CPI LOCKEY
       JZ LOCKIT   ; ALPHA LOCK
       CPI RSTKEY  ; LOCK RESET
       JZ RSTIT
       LXI H,KEYTAB ; KEY TABLE
       DAD B       ; ADD OFFSET TO START OF TABLE
       MOV A,M     ; READ CHAR FROM TABLE
       STA BUFFER  ; SAVE IT
       LDA LEARN   ; SEE IF LEARN MODE
       CPI 0
       JNZ LEARNT  ; GO SERVICE AS LEARN MODE KEY IF IN LEARN
       LDA BUFFER  ; GET CHAR AGAIN
       ANI 80H     ; CHECK MSB.  IF MSB=1, IS MULTI CHAR KEY.
       JNZ MULTIP
       CALL KEYOUT   ; NOT SPECIAL, JUST NORMAL CHAR.
       LXI H,WAIT  ; NOW STOP SCANNING UNTIL KEY IS RELEASED.  IF
                   ; KEY IS HELD DOWN FOR MORE THAN ABOUT .5 SEC,
                   ; START REPEATING KEY
WALOOP IN PBPORT   ; SEE IF KEY RELEASED
       CMA
       MOV B,A     ; SAVE ROW BITS
       LDA MASK
       ANA B
       JZ KEYUP    ; KEY RELEASED. GO RESET STROBE
       DCX H
       MOV A,H
       ORA L       ; LOOP UNITL HL=0
       NOP
       NOP
       JNZ WALOOP
       CALL KEYOUT ; OUTPUT KEY AGAIN
       LXI H,REPEAT  ; REPEAT DELAY CONSTANT
       JMP WALOOP
                   ;
                   ; NOW RESET STROBE
KEYUP  LDA TEMP
       ORI 80H     ; OR IN STROBE BIT
       OUT DATA
       JMP SCANLP
                   ;
                   ; LOCKIT SETS ALPHA LOCK MODE.
LOCKIT MVI A,1
IT     STA CAPLOC
       JMP KEYOFF
                   ;
                   ; RSTIT RESETS ALPHA LOCK MODE
RSTIT  MVI A,0
       JMP IT
```

More →

Listing continued.

```
                    ;
                    ; MULTIP OUTPUTS MULTI CHAR STRINGS FOR LEARNED
                    ; KEYS.
                    ;
                    ; FIRST, FIND START OF STRING
MULTIP LXI H,LRNTAB ; START OF TABLE
       LDA BUFFER   ; STRING NUMBER
       ANI 7FH
       DCR A
       MOV C,A
       JZ MULGOT     ; IF FIRST STRING, WE ARE ALREADY THERE.
                    ; C NOW CONTAINS THE STRING NUMBER - 1. THE
                     ; START OF THE STRING WILL BE FOUND BY FINDING
                     ; THE END OF THE PRECEDING STRING.
MULNXT MOV A,H      ; GET HI BYTE OF ADDRESS
       CPI 10H       ; SEE IF PAST END OF TABLE
       JZ KEYOFF    ; IGNORE KEY IF PAST END OF TABLE
       MOV A,M      ; GET CHAR
       INX H        ; BUMP POINTER
       ANI 80H      ; SEE IF MSB IS SET
       JNZ MULNXT   ; NOT END, LOOP.
                    ; HAVE FOUND END OF A STRING, DECR NUMBER OF
                    ; STRINGS TO SEARCH.
        DCR C
        JZ MULNXT
MULGOT MOV A,M      ; START OF STRING
       STA BUFFER   ; STORE FOR OUTPUT ROUTINE
       PUSH H       ; PROTECT H FROM DAMAGE
       CALL KEYOUT
       POP H
       MOV A,M      ; SEE IF CHAR SENT WAS LAST ONE
       ANI 80H      ; IF MSB = 1, WAS LAST CHAR IN STRING.
       JNZ KEYOFF   ; GO IF DONE SENDING STRING
       CALL OUTDLY  ; DELAY FOR HOST PROCESSOR
       INX H
       JMP MULGOT
                    ;
                    ; LEARNT CHECKS LRNCNT, WHICH IS THE COUNT OF
                    ; KEYS ENTERED SINCE LEARN MODE WAS TURNED ON.
                    ; IF LRNCNT IS 0, THE PRESENT KEY IS THE FIRST
                    ; KEY, WHICH IS THE ONE TO BE LEARNED.  IF
                    ; LRNCNT IS ONE, THEN THE PRESENT KEY IS THE
                    ; SECOND KEY, WHICH IS THE FIRST (AND POSSIBLY
                    ; ONLY) KEY TO LEARN.  IF LRNCNT IS 2, THEN
                    ; THE PRESENT KEY IS THE SECOND OF A MULTI-CHAR
                    ; STRING, AND THE LEARN TABLE MUST BE INITIALIZED.
                    ; IF LRNCNT IS GREATER THAN 2, THAN THE KEY MUST
                    ; BE PUT INTO THE TABLE.
                    ;
LEARNT LDA CNTL     ; SEE IF PRESENT CHAR IS CONTROL CHAR
       CPI 0        ; 1= CONTROL CHAR
       JZ LRNGO     ; NOT CONTROL CHAR-BRANCH
       LDA BUFFER   ; MAKE CHAR CONTROL CHAR
       ANI 1FH
       STA BUFFER
LRNGO  LDA LRNCNT
       CPI 0
       JZ KY2LRN    ; KEY TO LEARN
       LDA BUFFER   ; NOW CHECK FOR MULTI CHAR KEY, BECAUSE
       ANI 80H      ; MULTI CHAR KEYS CANNOT BE LEARNED
       JNZ KEYOFF
       LDA LRNCNT
       CPI 1
       JZ FIRLRN    ; FIRST LEARN KEY
       CPI 2
       JZ FIRMUL    ; START PROCESSING MULTI CHAR MSG
                    ;
                    ; LRNCNT IS GREATER THAN 2, SO PUT CHAR IN TABLE.
       LHLD POINT
       MOV A,H      ; SEE IF PAST END OF TABLE
       CPI 10H
       JZ KEYOFF    ; PAST END OF TABLE, IGNORE KEY.
       CALL KEYOUT  ; OUTPUT CHAR
       CALL WRPROM  ; WRITE CHAR TO TABLE
       LHLD POINT
       INX H        ; INCR (POINT) TO POINT TO NEXT TABLE LOCATION.
       SHLD POINT
       LDA LRNCNT
       INR A        ; INCR A
       STA LRNCNT
       JMP KEYOFF   ; GO WAIT FOR KEY TO BE RELEASED.
                    ;
                    ; FIRMUL IS ENTERED WHEN THE NUMBER OF KEYS TO
                    ; LEARN IS 2.  UNTIL THIS POINT, THE KEY TO
                    ; LEARN WOULD FIT IN THE NORMAL KEY TABLE.
                    ; SINCE THE STRING IS 2 OR MORE CHARS LONG, IT
                    ; MUST BE PLACED IN THE LEARN TABLE.  FIRMUL
                    ; MOVES THE VALUE IN THE KEYTABLE TO THE
                    ; (POINT), AND MOVES THE PRESENT KEY TO
                    ; (POINT)+1.
FIRMUL LDA LRNNUM   ; SEE IF LRNNUM IS 127, BECAUSE THAT IS THE
       CPI 127      ; MAX NUMBER OF ENTRIES ALLOWED.
       JZ KEYOFF
       LDA BUFFER
       PUSH A       ;PROTECT CURRENT KEY
       LHLD LRNADR
       MOV A,M      ; ADDR IN KEYTABLE OF KEY THAT WE ARE LEARNING
       STA BUFFER
       CALL WRPROM  ; WRITE LEARN TABLE WITH FIRST CHAR IN STRING
       LHLD POINT
       INX H
       SHLD POINT
       POP A        ; RESTORE CURRENT CHAR
       MOV B,A
       MOV A,H
       CPI 10H       ; SEE IF PAST TABLE
       JZ KEYOFF
       MOV A,B      ; CURRENT CHAR TO A
       STA BUFFER   ; STORE FOR WRITE
       CALL WRPROM  ; WRITE PROM
       LHLD POINT   ; INCR (POINT) TO NEXT CHAR
       INX H
       SHLD POINT
       CALL KEYOUT   ; ECHO KEY
       LDA LRNCNT   ; INCREMENT LRNCNT
       INR A
       STA LRNCNT
       JMP KEYOFF   ; WAIT FOR KEY RELEASE.
                    ;
                    ; KY2LRN IS ENTERED WHEN THE FIRST KEY IS PRESSED
                    ; AFTER ENTERING LEARN MODE.  THE PRESENT KEY
                    ; BECOMES THE KEY TO LEARN.  ON ENTRY, HL CONTAINS
                    ; THE ADDRESS OF THE PRESENT KEY, CALCULATED
                    ; IN THE KYDOWN ROUTINE.
KY2LRN SHLD LRNADR  ; STORE ADDR OF KEY TO LEARN
       LDA LRNCNT   ; INCR LRNCNT TO 1
       INR A
       STA LRNCNT
```

More →

Listing continued.

```
        JMP KEYOFF   ; WAIT FOR KEY TO BE RELEASED
                     ;
                     ; FIRLRN IS ENTERED WHEN THE NUMBER OF KEYS
                     ; ENTERED IN LEARN MODE IS 1.  THE PRESENT KEY
                     ; REPLACES THE KEYTABLE VALUE.
FIRLRN  LHLD POINT   ;PROTECT (POINT)
        PUSH H
        LHLD LRNADR
        SHLD POINT
        CALL WRPROM  ; WRITE PRESENT KEY TO KEY TABLE
        POP H        ; LEARN TABLE ADDRESS AGAIN
        SHLD POINT
        LDA LRNCNT   ; INCR LEARN COUNT
        INR A
        STA LRNCNT
        CALL KEYOUT
        JMP KEYOFF   ; WAIT FOR KEY RELEASE
                     ;
                     ; KEYOFF WAITS FOR THE ROW BIT CORRESPONDING
                     ; TO THE PRESENT KEY TO GO AWAY, INDICATING
                     ; THAT THE KEY HAS BEEN RELEASED.  KEYOFF
                     ; DOES NOT REPEAT THE KEY.
KEYOFF  IN PBPORT
        CMA
        MOV B,A
        LDA MASK     ; ROW MASK FOR CURRENT KEY
        ANA B
        JNZ KEYOFF
        JMP KEYUP    ; KEY IS UP, RESET STROBE
                     ;
                     ; DEBOUN PROVIDES KEY DEBOUNCE DELAY. USES A,B,C
                     ;
DEBOUN  NOP          ; DEBOUN JUST USES OUTDLY LOOP
OUTDLY  LXI B,WRDLY
OUTNXT  DCX B
        MOV A,B
        ORA C        ; LOOP UNTIL BC=0.
        JNZ OUTNXT
        RET
                     ;
                     ; RSTLRN RESETS LEARN MODE.  IF LRNCNT IS
                     ; GREATER THAN 2, THEN MULTIPLE CHAR
                     ; STRING WAS LEARNED.  IF SO, THEN THE
                     ; KEYTABLE LOCATION IS SET TO THE STRING
                     ; NUMBER, THE MSB OF THE LAST BYTE OF THE
                     ; STRING IS SET TO 1, AND LRNNUM, THE NUMBER
                     ; OF TABLE ENTRIES, IS INCREMENTED.  THE
                     ; REASON THAT ALL OF THESE OPERATIONS ARE
                     ; PERFORMED HERE IS SO THAT TURNING OFF
                     ; POWER DURING LEARN MODE WILL NOT HOSE UP
                     ; THE LEARN TABLE.
RSTLRN  LDA LRNCNT
        CPI 3
        JZ CLOSE     ; MULTIPLE STRING
        JNC CLOSE
        JMP LRNDON   ; NOT MUCH TO DO IF WE CANT CLOSE ANYTHING UP.
CLOSE   LHLD POINT
        DCX H
        SHLD POINT   ; HL DID POINT TO NEXT TABLE LOC, NOW POINTS
                     ; TO LAST CHAR OF CURRENT STRING.
        MOV A,M
        ORI 80H      ; SET MSB TO INDICATE LAST CHAR
        STA BUFFER
        CALL WRPROM  ; WRITE LAST CHAR
        LDA LRNNUM
        INR A        ; INCR # ENTRIES
        STA BUFFER
        LXI H,LRNNUM ; ADDRESS OF LRNNUM
        SHLD POINT   ; STORE FOR WRITE
        CALL WRPROM
        LHLD LRNADR  ; SET KEYTABLE LOC TO STRING NUMBER
        SHLD POINT
        LDA LRNNUM   ; LEARN NUMBER
        ORI 80H      ; OR IN MSB TO INDICATE MULTI CHAR STRING
        STA BUFFER
        CALL WRPROM  ; WRITE STRING TABLE ENTRY NUMBER TO KEYTABLE
LRNDON  MVI A,0      ; RESET LEARN MODE
        STA LEARN
        JMP SCANLP
                     ;
                     ; ERASE IS ENTERED WHEN CONTROL, SHIFT, AND
                     ; LEARN ARE HELD DOWN SIMULTANEOUSLY.  ERASE
                     ; CLEARS ALL MULTI CHAR STRING ENTRIES FROM
                     ; THE LEARN TABLE.
ERASE   LDA LRNNUM   ; SET LRNNUM TO 0
        STA LRNCNT   ; STORE IT SOMEWHERE
        LXI M,KEYTAB ; KEYTABLE
        MVI B,129    ; 128 ENTRIES IN KEYTABLE
ERAGAN  MOV A,M      ; GET KEYTABLE ENTRY
        DCR B
        JZ ERDON     ; ALL 128 CHECKED
        ANI 80H
        JZ ERAINC
        MVI A,0      ; STRING NUMBER FOUND, ZERO IT
        STA BUFFER
        SHLD POINT   ; STORE WRITE ADDR
        PUSH B       ; PROTECT BC AND HL BECAUSE WRPROM USESES THEM
        PUSH H
        CALL WRPROM
        POP H        ; RESTORE BC AND HL
        POP B
ERAINC  INX H
        JMP ERAGAN   ; LOOP UNTIL ALL OF KEYTABLE CHECKED
ERDON   MVI A,0      ; NOW ZERO LRNNUM
        STA BUFFER
        LXI H,LRNNUM
        SHLD POINT
        CALL WRPROM
ERAWAT  IN PBPORT    ; NOW WAIT FOR SHIFT, CONTROL AND LEARN TO
                     ; NOT ALL BE ACTIVE.
        ANI 70H
        JNZ SCANLP
        JMP ERAWAT
                     ;
                     ; WRPROM WRITES DATA IN (BUFFER) TO EEPROM
                     ; AT (POINT).  BEFORE WRITING, WRITE ROUTINE
                     ; IS MOVED TO RAM, SINCE THE ROM CANNOT BE
                     ; READ WHILE THE WRITE IS OCCURING.
WRPROM  MVI B,40H    ; 64 BYTES TO MOVE
        LXI H,WRRTN
        LXI D,3020H  ; DESTINATION OF MOVE
WRAGN   MOV A,M
        STAX D
        INX H
        INX D
        DCR B
        JNZ WRAGN    ; LOOP UNTIL ENTIRE ROUTINE MOVED
        JMP 3020H    ; GO WRITE PROM
WRRTN   LHLD POINT   ; ADDRESS TO WRITE
```

More →

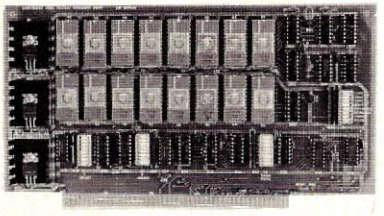
```
        MVI A,0
        OUT TIRMLO
        MVI A,0FFH
        OUT TIMRHI      ; TIMER NOW SET FOR ABOUT 12 MS DELAY
        MVI A,0CDH
        OUT CMDPRT
        MVI A,0FFH
        MOV M,A         ; FIRST, WRITE 0FFH TO EEPROM, BECAUSE
                        ; SOME EEPROMS MUST BE ERASED BEFORE THEY
                        ; CAN BE PROGRAMMED.  THE WRITE TO THE
                        ; EEPROM WILL BE EXTENDED BY THE 8085 READY
                        ; LINE UNTIL THE 8156 TIMER TIMES OUT.  THIS
                        ; WILL TAKE ABOUT 12 MS.
        MVI A,04DH      ; NOW STOP TIMER
        OUT CMDPRT
        LXI B,1         ; NOW DELAY.  THE PROGRAM SETS BC TO 1 FOR
                        ; A SINGLE DELAY, BUT SOME EEPROMS NEED
                        ; 50 OR SO MICROSECONDS TO RECOVER FROM A
                        ; WRITE, SO FOR THESE, THIS LOOP SHOULD BE
                        ; LONGER.
WL1     DCX B
        MOV A,B
        ORA C
        JNZ 3039H       ; JNZ WL1
        MVI A,0
        OUT TIMRLO
        MVI A,0FFH
        OUT TIMRHI
        MVI A,0CDH
        OUT CMDPRT
        LDA BUFFER
        MOV M,A         ; NOW WRITE DATA. SAME COMMENTS APPLY AS IN
                        ; ERASE DATA CODE, ABOVE.
        MVI A,04DH
        OUT CMDPRT
        LXI B,1         ; SAME DELAY COMMENT AS ABOVE
WL2     DCX B
        MOV A,B
        ORA C
        JNZ 3056H
        RET
                        ;
                        ; KEYOUT OUTPUTS CHAR IN BUFFER TO DATA PORT.
                        ; IF KEY IS LC ALPHA, AND ALPHA LOCK MODE IS
                        ; IS ON, THE KEY IS SHIFTED.  IF CONTROL IS
                        ; ACTIVE, THE KEY IS CONVERTED TO A CONTROL
                        ; KEY.
KEYOUT  LDA CAPLOC      ; ALPHA LOCK
        CPI 0
        JZ KYNOCL       ; NO ALPHA LOCK, GO CHECK CONTROL
        LDA BUFFER
        ANI 7FH         ; STRIP MSB
        CPI 7BH         ; LOWER CASE Z+1
        JNC CTLCHK      ; KEY IS GREATER THAN 7A, SO ISNT LC ALPHA.
        CPI 61H         ; LOWERCASE A
        JC CTLCHK       ; LESS THAN LC A, SO ISNT LC ALPHA AT ALL.
        ANI 5FH         ; STRIP LC BIT
        JMP CTLCHK
KYNOCL  LDA BUFFER
CTLCHK  MOV B,A         ; SAVE CHAR IN B
        LDA CNTL
        CPI 0
        JZ GOOUT        ; NOT CNTRL CHAR
        MOV A,B
        ANI 1FH         ; STRIP MS BITS OF CHAR
        MOV B,A
GOOUT   MOV A,B         ; CHAR TO A
        ORI 80H         ; OUTPUT WITH MSB=1 (STB=0)
        OUT DATA
        PUSH B
        CALL OUTDLY
        CALL OUTDLY ; DELAY ABOUT 30 MS.
        POP B
        MOV A,B
        ANI 7FH         ; MAKE MSB=0.
        OUT DATA
        STA TEMP        ; STORE CHAR FOR KEYUP ROUTINE.
        RET
                        ;
      ; THATS ALL, FOLKS ( END OF PROGRAM. START OF TABLES )
      ;
LRNNUM DB 0             ; NUMBER OF TABLE ENTRIES
                        ;
                        ; START OF KEYTABLE.  TABLE IS 128 BYTES LONG FOR
                        ; 64 KEYS.  SHIFTED KEYS ARE TREATED AS
                        ; SEPERATE CHARACTERS.  DATA IS ARRANGED WITH
                        ; COLUMN ADDRESS BEING THE LEAST SIGNIFICANT.
KEYTAB DB 0,61H,62H,63H ; ROW 0, RST, A B C
       DB 64H,65H,66H,67H ; DEFG
       DB 68H,69H,6AH,6BH ; HIJK
       DB 6CH,6DH,6EH,6FH ; LMNO
       DB 70H,71H,72H,73H ; ROW1 PQRS
       DB 74H,75H,76H,77H  ; TUVW
       DB 78H,79H,7AH     ; XYZ ALL LC ALPHA DONE
       DB 11H,7FH,5BH,0    ; CLEAR ERASE INP, TEST, EOF
       DB 0,30H,31H,32H    ; PA1, 0 1 2
       DB 33H,34H,35H,36H ; 3 4 5 6
       DB 37H,38H,39H,0BH ; 7 8 9 ->
       DB 3BH,0,3DH,0      ; ; = PA2
       DB 0,0,0            ; INS MODE, NO KEY, NO KEY
       DB 0AH,20H,8,0DH    ; DOWN ARROW, SPACE, BS, ENTER
       DB 7FH, 0 0 1FH     ; DEL LOCK, UP ARROW
       DB 27H,2DH,2CH,5EH ; ' - , MUL
       DB 2EH, 2FH         ; . /
                           ;
                           ; SHIFTED CHARS
       DB 0,41H,42H,43H,44H  ; A B C D
       DB 45H,46H,47H,48H    ; E F G H
       DB 49H,4AH,4BH,4CH    ; I J K L
       DB 4DH,4EH,4FH,50H    ; M N O P
       DB 51H,52H,53H,54H    ; Q R S T
       DB 55H,56H,57H,58H    ; U V W X
       DB 59H,5AH            ; Y Z
       DB 0,0,0,5DH,0
       DB 29H,7CH,40H,23H,24H ; ROW 2 ) ! @ # $
       DB 25H,5CH,26H,2AH     ; % ^ & *
       DB 28H,0BH,3AH,0       ; ( -> : !<-
       DB 2BH,0,0             ; + PA2 INS
       DB 0,0                 ; NO KEY
       DB 0AH,20H,08H,0DH     ; DOWN ARROW SPC, BS, CR
       DB 7FH,0,0,1FH
       DB 22H,2DH,3CH,21H     ; " - < !
       DB 3EH,3FH             ; > ?
                              ;
                              ; START OF LEARN TABLE.  DATA IS
                              ; ARRANGED AS ASCII CHARS IN SEQUENTIAL
                              ; LOCATIONS.  THE LAST CHAR IN ANY
                              ; STRING HAS THE MSB SET TO 1.
LRNTAB DB 0                   ; FIRST BYTE OF TABLE
```

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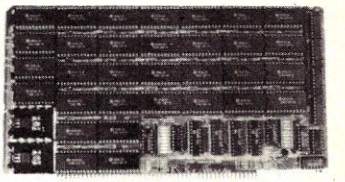
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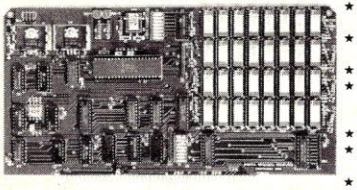
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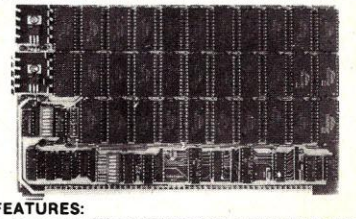
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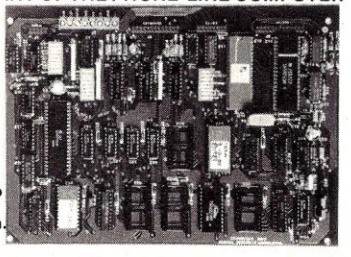
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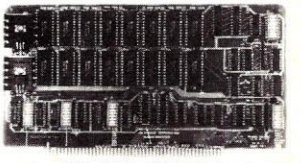
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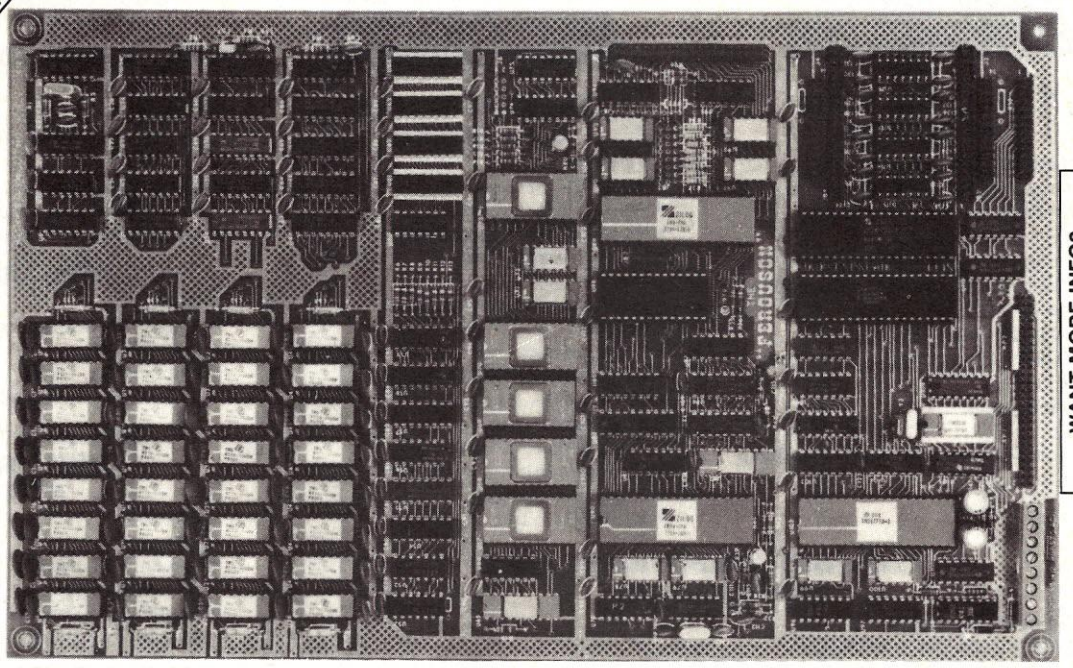
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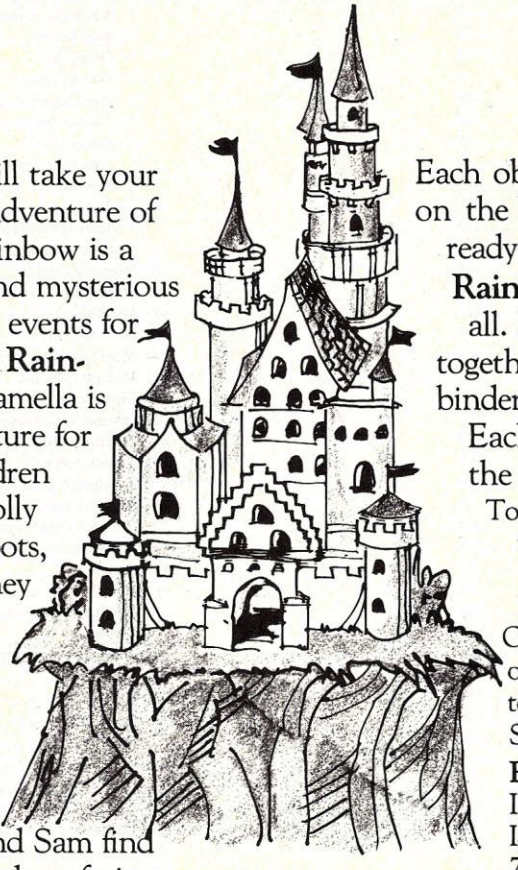
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The C Programming Language
Kernighan/Ritchie
Prentice-Hall, 1978
Englewood Cliffs, NJ 07632
Softcover, 230 pp., $19.95

Learning to Program in C
Dr. Thomas Plum
Plum Hall, 1983
1 Spruce Ave.,
Cardiff, NJ 08232
Softcover, 350 pp., $25

The C Primer
Hancock/Krieger
McGraw-Hill, 1983
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Softcover, 235 pp., $16.95

The C Puzzle Book
Alan R. Feuer
Prentice-Hall, 1982
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The C programming language has gained popularity by leaps and bounds in recent months with the increasing availability of the Unix operating system. The purpose of this article is to tell you a little about C and then review the four books that are suitable for further study of the language.

The C language, created by Dennis Ritchie of Bell Laboratories, was designed for the purpose of writing operating systems and systems software such as assemblers and compilers. Although Unix was originally written in assembly language, it has been rewritten in C. In Unix, the C compiler and all the standard utilities are also written in C.

History Makes the Difference

This history makes C different from most other languages in two ways.

First, unlike Ada, C was designed by a single individual rather than a committee. This is probably why C is a small language. The core of C offers all the commands necessary to utilize the capabilities of the hardware and little more. It also allows you to easily define your own extensions to do things that you want. This makes it possible to write efficient programs that are portable to different computer systems (based on different microprocessors) with little modification.

Second, it was written by a programmer and designed to be used for programming a specific type of application: systems software. As a result, it's very well-suited for this specific use. This makes C different from a language such as Pascal, which was written by a teacher for the purpose of teaching programming language concepts. (Pure Pascal offers a lot of structure that is not needed by the serious programmer and lacks many of the low-level functions necessary to really get the job done.)

Let me say a few things about the capabilities of C, and then I'll review the books that are available. C offers data types to represent characters, integers and real numbers and sets of operations that can be performed on this data. Essentially, all the operations that the hardware is capable of performing (such as bitwise And and Shifting) are available in C as well as the mathematical operations (add, subtract, multiply, divide, remainder), which are probably performed by a sequence of hardware instructions rather than a single one.

C's a Free Spirit

The general flow of control statements and the use of functions encourage you to write your programs in a structured manner. If you have a real need for the Goto statement, it also exists. Since C source is free form and the compiler has a string-oriented preprocessor, you have the capability of writing either pretty, easily maintained programs or complete disasters, as Basic encourages. The choice is yours—C doesn't get in your way; it just offers you the options.

If you have further interest in this language, I suggest that you buy a book on C. To help you with your purchase, I've reviewed four books on C.

Father's Bible

Whenever you talk about books on C, its Bible, *The C Programming Language*, must be mentioned first. Computer scientists Brian W. Kernigham and Dennis M. Richie (the father of C) wrote the book as a practical reference for C with a brief tutorial introduction. In eight chapters and 230 pages, the book covers types and operators, control flow, functions and program structure, pointers and arrays, structures and input/output. It also talks about the interface to the Unix operating system.

The C Programming Language is well-written, concise and error free, important requirements for a programming language book. The book is an asset no serious C programmer should be without. The wear and tear on my copy shows that it's needed.

Now, if Kernighan and Ritchie's book is so wonderful, why does the world need more C books? Well, as I said, it was written by computer scientists as a reference. If you're a fairly sophisticated systems programmer, you can learn C with a copy of this book, a C compiler and a lot of patience. I did.

On the other hand, if your knowledge about computer hardware or your programming experience is limited in a structured language, you're apt to find this book very hard to read. It doesn't spend a lot of time bringing you up to speed. This isn't a criticism of the book, just a limit to its scope.

More Room to Play

For those of you who admit that you aren't sophisticated systems programmers, *Learning to Program in C* by Dr.

Thomas Plum will instruct you. Plum's experience in teaching C programming and professional seminars on C and Unix is reflected in his approach and the quality of his book.

The C compiler relieves you of the drudgery of knowing what is in register 4 and offers the control structures necessary to write Goto-less code, but doesn't tie your hands. Because of this, it's important to understand how a computer works in order to be comfortable writing in C.

Plum has recognized this and dedicates the first chapter of his book to explaining hardware and its relationship with C. For those who aren't particularly hardware oriented, this makes the difference between C being a foreign language and a logical approach to using a tool that's already available.

A Step Forward

The remainder of the book is divided into chapters on data, operators, statements and control flow, functions, software development, pointers and structures of most of the pieces of the C language. Essentially, this same material was presented in Kernighan and Ritchie's book, but with a different approach. Plum takes it a step further. He describes each language feature, illustrates its use and discusses how or why to use it.

What this means is that you learn style considerations as you learn C. Thus, you're more likely to write programs that are both correct and easy to maintain from the start.

Plum also ties many of the concepts to the hardware, so that you can see what happens. Even if you don't understand the hardware, you can still understand the book if you're willing to learn what Plum presents; if not, you'll never be comfortable programming in C.

Troubles and More Troubles

There are numerous examples and problems left for the reader to solve. It's a well-designed classroom text, but it tells you all you need to learn C on your own. In addition, the presentation of technique means you can learn how to do things correctly as you learn them, rather than having to learn style afterwards.

This book contains about 350 pages with examples in special tear-out sections so you can type them into a computer and see what happens. I have a copy of the first printing of the book (now sold out) and only managed to find four typos (although I am sure I missed some). I consider this an amazing feat which can only be explained by the fact that Dr. Plum typeset the book himself.

I was seriously considering writing a tutorial on C. The quality and approach of this book has convinced me that my time is better spent working on C and Unix reference booklets. As yet, I haven't seen this book in the stores. If you can't find it, contact Plum Hall, 1 Spruce Ave., Cardiff, NJ 08232. They should be able to direct you to a store or sell it to you directly.

Beginner's Prime

The third book I'd like to discuss is *The C Primer* by Les Hancock and Morris Krieger. This is a 235-page book that promises to be for beginners. The book begins with chapters on what C is and how C looks to show you the basics. It then goes into data types, storage classes, operators, control structures, functions, arrays, pointers and structures. There's also a chapter on the C preprocessor. Essentially, it covers all the basic concepts of C except file input and output.

The beginning of the book presents some history and shows the steps the machine takes to translate C into an executable program. This program is fairly well-done except for an occasional expression, such as hand-execute, that is meaningless to the novice.

One of my biggest reservations about this book is the wording. For example, a program is described as converting Arabic to Roman numerals. This sounds simple, but actually the program converts a binary number into a character string that is the Roman numeral equivalent.

To me this seems misleading, particularly in the first few pages of a book for beginners. I would have preferred clearer examples in order to avoid confusion.

The sections on pointers and structures, both hard concepts to grasp, are done in an easy-to-understand manner. Mailboxes are used to describe pointers. This is similar to the approach that Plum takes in describing the computer hardware in the beginning of his book.

Opinion or Gospel

I have the first printing of Hancock and Krieger's book. The book seems relatively free of typos but has some errors in its examples. For example, the program on page 73 does not do what it says it does. Also there are statements of opinion that are presented as gospel. I hope that these errors are corrected in future printings.

The book has no practice exercises for the student to work out. This is by design and the authors suggest that you see *The C Puzzle Book* for your examples. I feel that this is a mistake. The only way you'll learn C is to use it. Without any exercises, it will be hard to see if you understand the concepts. One possible solution would be for the authors to make references to appropriate problems in *The C Puzzle Book*.

Mastering the Puzzle

The C Puzzle Book by Alan R. Feuer contains 175 pages of puzzles and answers designed to test your skills in C. It's not a tutorial or reference, nor is it intended to be. The author calls it a workbook and I agree. It's intended to be used in conjunction with a tutorial or reference in order to test your skills and understanding.

When I first got a copy, I felt that it was a waste of time. I tried a few more puzzles and started getting the answers wrong. It really is a test of skills and if you can skip through the book and get every problem right, then you're assured of having a thorough understanding of C.

> Plum's book has numerous examples and problems for the reader to solve—it tells you all you need to know to learn C on your own.

It starts off with simple puzzles involving only the basic arithmetic operators and expands until all types of operators and operator precedence have been tested. Next it deals with data types and how type conversion occurs as well as control flow, programming style, storage classes, pointers, arrays and structures. Finally, the last chapter tests your understanding of the preprocessor with solutions presented for all problems.

This book is error free and presented in a logical order for testing your skills. Even if you think you know it all, it's worth a try. It's a cheap price to pay for so much reinforcement.

Which is Best?

Well, if you haven't fallen asleep yet, let me give you my opinion on which books you should purchase in order to become a C expert. First, if you intend to really learn C and use all its capabilities, *The C Programming Language* is a must. After all, it's the voice of the father of C, is well-written and is the best reference once you seriously know the language. If you're not yet sure whether you're serious about C, you can save this purchase for later. Buy a tutorial first. For the systems programmer this may be enough. For mere mortals, let me go on.

Learning to Program in C is the best tutorial on the C language. It stresses the areas where C excels, teaches you about non-C things, such as hardware and program design, that you need to know in order to be a good programmer and presents it all in a clean, concise, error-free manner. If you're serious and need a tutorial, this is your best bet.

The C Primer is again a tutorial. It develops the features of C fairly well. For someone who wants to take a look at C and possibly dabble with it, the book is probably adequate. Just watch for errors and remember that you'll have to get sample problems from another source.

It took only a few pages of McWilliams' book to dissolve my skepticism—he presents a lucid, no-nonsense account of word processing.

The C Puzzle Book is just that, a book of puzzles. It's not a book for teaching you C, but once you start learning C, it's a great way to test your skills. Again, if you only intend to dabble with C, it's probably not worth purchasing. If, however, you're either a current C user or plan to become an expert, it's a great vehicle for checking your knowledge.

Phil Hughes
Mercer Island, WA

The Word Processing Book

Peter A. McWilliams
Prelude Press, 1983
944 Palm Ave.,
Los Angeles, CA 90056
Softcover, 281 pp., $9.95

If there's one thing guaranteed to catch a computer jock's eye, it's a book that calls itself "A Short Course in Computer Literacy."

While browsing at the local bookstore, my peripheral vision homed in on the subtitle of Peter McWilliams's book from two aisles away. I picked up the oversized paperback and paged through it.

Incredibly, the author has no computer credentials, no ACM (Association for Computing Machinery) or IEEE (Institute of Electrical and Electronics Engineers) affiliations, no formal education in computer science and no employment at a hi-tech Silicon Valley firm. As a matter of fact, his previous book is a collection of poems. Is this another case of a rookie masquerading as an authority on word processing?

Running Tight

Computer alchemists run in a tight pack. The technical transoms exclude all but the most aggressive from the "bit-bangers" club. I won't call myself an expert on the subject (today's expertise can be found at tomorrow's booth at the Smithsonian). Nonetheless, I have paid my dues.

While collecting a paycheck for more than ten years as a programmer, I have soothed overheated RAMs, tractor-fed continuous forms and coded in the hieroglyphics of assembly language. Thus, it was with some trepidation that I regarded McWilliams's treatise. Probably another amateur getting in over his head.

It took only a few pages of *The Word Processing Book* to dissolve my skepticism. McWilliams succeeds at what the heavy-handed tomes that dominate the industry fail at miserably; he presents a lucid, no-nonsense account of word processing. The author may not have the technical prowess of one of the main characters of *The Soul of a New Machine*; however, his warmth, humor and witty anecdotes make for effortless sailing through an esoteric subject. After a chapter or two, the pleasure of sharing his experiences soon becomes a more compelling reason for reading than the goal of learning word processing.

It's Elementary, Watson

Yet one does learn. The author teaches effectively. He breaks down the abstractions of RAMs, ROMs and CPUs into manageable mouthfuls that can be digested easily. Seasoned professionals and knowledgeable word processing users may find this primer elementary. However, those already familiar with the subject will laugh at McWilliams's comical insights.

The author wastes no time in setting the stage for merriment. If for nothing else than its multithousand dollar expense, word processing usually warrants serious, ponderous discussion, but McWilliams finds plenty of room for humor. He laughs at computer junk mail and such computer jargon as "the world's 297th language" and the computers of yesteryear: If you [then] wanted a personal computer to balance your household budget, you would have to buy an additional house just to put it in.

Indeed, nothing is sacred, not even the author. "I'm an awful speller . . . I'm lousy at alphabetical order, too," he concedes while applauding the merits of spell check programs that will "forever end the curse of Noah Webster."

I Dream of Genie

Readers revel in his wit, while McWilliams, the personal computer guru, dishes up a word processing plate for everyone. He individually addresses the needs of office workers, students, writers, self-employed professionals and even poets. Then he demonstrates how a job can be aided and abetted by a word processor.

In his view, these modern technological marvels are electronic genies dedicated to taking the drudgery out of expressing yourself on the printed page, leaving more time for designing, inventing and even playing a few games of Space Invaders.

For the prospective buyer of a word processing system, the book pays for itself in the chapter, "A Brand Name Buying Guide." The author devotes 100 pages to weighing the pros and cons of dozens of software packages, printers and computers. He gives advice on haggling with the local computer store and mail ordering from a computer emporium.

More importantly, he steers the novice away from the living room computers that don't adapt well to word processing, like Apple, Atari and Radio Shack systems. Included in this category of things to avoid are dedicated word processors, those computers designed for word processing only. "The dollar-for-dollar value of these dedicated units, when compared with regular, programmable PCs, is low."

A liberal sprinkling of woodcuts, steel engravings and photographic illustrations further embellish the spunky tone of the text. Most of the illustrations depict premedieval settings (with the exception of photos that show off-the-shelf computers).

To relate the austere drawings to the subject matter at hand, the author invokes writer's license and dubs in his own captions. What results are heretofore unrecorded scenes such as "the Pharaoh's daughter finding a word processor floating in the stream."

At the risk of being accused of not leaving well enough alone, I will offer one bit of advice to the author. In the next edition (this edition is the fifth) please add an index. The book reviews 28 computer systems and over a dozen word processing software packages. Quick reference to one of these requires sequential searching through the table of contents. The task is made more frustrating in that the products aren't listed in alphabetical order.

On the whole, McWilliams lives up to his sobriquet as "The Dr. Spock of Personal Computers." He has, in his own words, "studied at the feet of the silicon masters" and now wants to welcome his "typist-tossed" shipmates to the world of word processing. This book is an endearing invitation to that end. The novice will find it as valuable as an idiomatic phrase book in a foreign country. To those who are already computer connoisseurs, this book won't expand your technical horizons, but read it anyway. McWilliams will lead you to undiscovered delights in a territory as familiar as your backyard.

Edward Joyce
Charlottesville, VA

Proportional Spacing on Wordstar

Writing Consultants
11 Creek Bend Drive
Fairport, NY 14450
Softcover, 78 pp., $19.95

Who knows what secrets lurk in the heart of WordStar? *Proportional Spacing on WordStar* shows you one of the secrets buried in the innards of WordStar

and teaches you how to use it.

Many long-time WordStar afficionados have been aware of an undocumented ↑P↑P proportional printing command that remains unofficial because it doesn't quite work. Writing Consultants overcomes this lack in WordStar. It enables you to produce proportionally spaced printing on most daisy-wheel printers, including the Diablo 620 and 630; Qume Sprint 5, 9 and 11; NEC Spinwriter; C. Itoh printers and other printers modeled after them.

The comparison to text produced with a nonproportional print wheel, even with WordStar's microjustification, can be quite striking. The short sample in exhibit A doesn't give you the full effect of a long manuscript, but it illustrates the adjustments to various letters.

If you want to produce camera-ready copy for offset printing of manuals or similar text, this manual is valuable in upgrading the quality of your printed product to emulate typeset copy. An additional patch that increases the number of times double strike hits a character darkens copy in your final printout, which adds to the typeset appearance.

Surprisingly, the combination of some regular printwheels (rather than proportional wheels) with the proportional spacing table and a slightly different character width setting than normal often improves the look of your text.

WordStar users with version 3.3 are taught to call the built-in patcher hidden in the Winstall program, WordStar's installation program, to gain access to areas other than those listed on the installation menus. Complete step-by-step instructions with screen prompts and responses are provided for version 3.3 as well as prior versions.

All information necessary to make changes in the proportional spacing table is provided. No technical skills or knowledge of assembly language is required. You can further adjust the spacing for any letter. None of the normal features or operations of WordStar are altered in any way by your patches.

Uppercase headings and even single words in capital letters may upset WordStar's proportional printing logic. Easy pragmatic solutions to these problems are included, with the text serving as a living example of the excellent results that can be obtained.

If you have ever suffered the frustration of trying to use the column move function of WordStar to print in multiple columns for a newsletter or similar publication, you know that microjustification causes the columns to be out of alignment. *Proportional Spacing* includes a technique to overcome this problem and enables you to produce properly justified multicolumn documents.

The index is preceded by a proportional spacing command summary for the Xerox word processing program based on WordStar. The summary includes samples of print and character sets for various proportional printwheels and a handy conversion table for adjusting margins to different character widths. Writing Consultants has even tossed in phone numbers of sources that supply proportional printwheels if you can't find them locally.

If you've been impatiently waiting for MicroPro to fix their proportional spacing tables and the difference between the appearance of typewritten and almost typeset quality is important to you, *Proportional Spacing on WordStar* is a must for your library. Writing Consultants has furnished a workable solution that will substantially improve your document output at a reasonable price.

Charles R. Perelman
Los Angeles, CA

Writing Consultants has furnished a workable solution that will substantially improve your document output at a reasonable price.

From the MC Bookshelf

The MC Bookshelf is stocked full with books on WordStar. This month we will look at six of the more notable titles and present a handy selection of "How to" books.

- *Getting the Most from WordStar and MailMerge* by M. David Stone (Prentice-Hall, Inc., Englewood Cliffs, NJ 07632; $14.95) is a comprehensive guide that takes you through the sophisticated capabilities of the software.
- Arnold Rosen's *Getting the Most Out of Your Word Processor* (Prentice-Hall, Inc., Englewood Cliffs, NJ 07632; $9.95) covers all the functions, features and applications of modern day word processing.
- *WordStar with Style* by Roger B. White, Jr. (Reston Publishing Co., Inc., Reston, VA 22090; $14.95) shows you how to design WordStar to fit your needs.
- *Using the IBM Personal Computer; WordStar* by C.J. Puotinen (Holt, Rinehart and Winston, 383 Madison Ave., New York, NY 10017; $18.45) is written for the 3.2 version of WordStar and for the IBM PC Disk Operating System version 1.1.
- John D. Lee's *WordStar and CP/M Made Easy* (John Wiley & Sons, Somerset, NJ 08873; $17.95) provides basic and advanced program uses with working examples and exercises at each stage of development.
- *The Illustrated CP/M WordStar Dictionary* by Russel A. Stultz (Prentice-Hall, Inc., Englewood Cliffs, NJ 07632; $14.95) describes and illustrates the ten most commonly used CP/M commands and 63 WordStar word processing operations.

To begin our selection of new "How to" books is Jess W. Curry, Jr. and David M. Bonner's *How to Find and Buy Good Software*. Their book guides businessmen and professionals through an eight-step approach to choosing software. It is published by Prentice-Hall, Inc., Englewood Cliffs, NJ 07632; $9.95.

- *How to Microcomputerize Your Business* by Jules A. Cohen, Catherine Scott McKinner and the staff of Orbis (Prentice-Hall, Inc., Englewood Cliffs, NJ; $7.95) spells out all your options and warns you of potential pitfalls on the road to a computerized business.
- *Making Information Systems Work For You* by Trevor Bentley and Irvine Forkner (Prentice-Hall, Inc., Englewood Cliffs, NJ; $8.95) helps businessmen make better use of their mangement information systems.
- *The Whole Computer Catalog* by Designs III Publishers (Fullerton, CA 92632; $35) is a veritable who's who of manufacturers, consultants, associates, publishers and other professionals in the computer field.
- *Microcomputer Software Design* by Sally Cambell (Prentice-Hall, Inc., Englewood Cliffs, NJ 07632; $12.95) helps you design complex programs in all languages.
- *Applesoft Basic: From the Ground Up* by Henry Mullish and Dov Kruger (McGraw-Hill Book Company, 1221 Avenue of the Americas, New York, NY 10020; $10.95) is a comprehensive guide with many examples of structured programs and details of the language's features and commands.
- *Programming with Graphics* by Garry Marshall (Prentice-Hall, Inc., Englewood Cliffs, NJ 07632; $12.95) is a nonmathematical, up-to-date explanation of the three major methods of producing microcomputer graphics displays: block, pixel and line.
- Owen Bishop's *Simple Interfacing Projects* (Prentice-Hall, Inc., Englewood Cliffs, NJ 07632; $10.95) provides you with ten interfacing projects that can be adapted for use on any microcomputer.
- *The Naked Computer* by Jack B. Rochester and John Gantz reflects the vibrant computer market. Filled with facts, historical nuggets and amusing anecdotes, it is the complete source book on the personalities of the computer field. Anyone who loves computers should love this almanac. (William Morrow & Company, Inc., New York, NY 10016; $15.95.)

CALENDAR

New York Networking

On May 2 and 3, Frost & Sullivan will sponsor a conference on networking personal computers. The conference will be at the Holleran House in New York City. For more information, contact Ginny Kania, account representative, Frost & Sullivan, 106 Fulton St., New York, NY 10038; 212-233-1080.

IBM, Lamond and Gemini

Cap Gemini DASD, an international data processing organization, will sponsor two IBM lectures this month. Fred Lamond, regarded as one of the world's leading experts on IBM, will speak on alternative growth strategies for IBM users. Lamond will also address the question of IBM PCs replacing 3270 terminals as well as discuss other current topics.

Lamond will lecture May 2–4 at the Westin Miyako in San Francisco, CA and May 7–9 at the Sheraton International Conference Center in Washington, DC. For more information on either seminar, contact the Cap Gemini DASD headquarters at 800-558-5148 or 414-355-3405.

Apple Meets IBM

The Personal Computer Userfest is scheduled to be held in both New York and Chicago. The Userfest is a combination of last year's popular Applefest and PC'83 and will feature products that apply to both the IBM PC and Apple microcomputers.

In addition, workalike and lookalike computer manufacturers have been invited to participate in this year's events. The Chicago show will be May 3–6 at the O'Hare Exposition Center. New York's show is slated for September 20–23 at Madison Square Garden.

For more information on either show, contact Northeast Expositions, 822 Boylston St., Chestnut Hill, MA; 800-841-7000, or from within Massachusetts, 617-739-2000.

Cambridge Computer Conference—Cambridge, MA

Lesley College and the Computer Education Resource Coalition are cosponsoring the sixth annual Computer Conference for Educators. The event will be at Lesley College in Cambridge, MA on May 5.

The program will feature several presentations as well as workshops and a panel debate. For registration information, contact Susan Friel or Nancy Roberts at Lesley College, 29 Everett St., Cambridge, MA 02238; 617-868-9600.

Salt Lake City Seminar

The Automation and Computer Planning Exhibit is scheduled for Salt Lake City, UT on May 6–9. The event, sponsored by the Industrial Development Research Council, will be at the Hotel Utah. The object of the exhibit is to present an overview of the integrated office of both today and the future.

Hardware and software companies have been invited to show products relevant to integrated, automated office supplies. The exhibit is in conjunction with the council's spring professional seminar. For more information, contact James D. Mathis, program manager, at IDRC headquarters: 404-458-6062.

H-P Seminars

Hewlett-Packard Co. continues its spring series of systems and solutions seminars in May with shows in Detroit, Minneapolis and Chicago.

Productivity '84 features demonstrations and displays that explore ideas and solutions about increased productivity. May 8 and 9, the show will be in Detroit, MI at the Michigan Inn; May 15 and 16, the seminar will convene in Minneapolis, MN at the Raddison South; and May 30 and 31, Chicago, IL will host the seminar at the Hyatt Regency. For more information, call 800-554-4466.

Graphics '84 in Anaheim

The National Computer Graphics Association is sponsoring its fifth annual conference, Computer Graphics '84, in Anaheim, CA on May 13–17. The show will feature more than 200 exhibitors and address issues such as CAD/CAM, visual arts, cartography and architecture and engineering, to name but a few.

Industry experts and educators will conduct tutorials and more than 70 technical sessions. The NCGA annual dinner will also be on May 15 and feature a series of video presentations.

For more information on the conference, exposition and special events, contact the NCGA at 8401 Arlington Blvd., Suite 601, Fairfax, VA 22031; 703-698-9600.

Double Bill in Boston

Two computer events will be in Boston, MA on May 15–17. Electro/84, a high technology exhibition and convention, will be at the Bayside Exposition Center. The northeast edition of Mini/Micro '84 will be held at the Hynes Auditorium.

For further information on either show, contact Nancy Hogan or Kent Keller, 213-772-2965.

Compufair '84—Penn State

On May 19, the Northeastern Pennsylvania Amateur Computer Club and the Penn State University, Hazelton Campus, will host their third annual computer fair. Compufair '84 will feature seminars, workshops, vendor displays and demonstrations by various users groups.

The fair will be held on the Hazelton Campus of the University. For more information, call 717-454-8731.

ASIS Micro Revolution—IN

The American Society for Information Science will hold its thirteenth midyear meeting in Bloomington, IN on May 20–23. The theme of this year's meeting is The Micro Revolution: Implications for the Information Age. Joseph Weizenbaum, a computer science professor at MIT and computer author, will be the keynote speaker.

The meeting will be on the campus of the Indiana University. For more information, contact Stephen Harter, School of Library Information Science, Indiana University, Bloomington, IN 47405; 812-335-5133.

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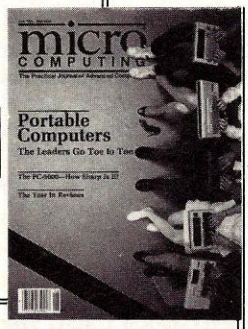
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The PASS PC in the Lone Star State

Personnel Data Systems will hold its 1984 annual users conference in Dallas, TX on May 20–23. The highlight of the conference will be an on-line demonstration of PASS PC, the company's new personnel software system for the IBM PC.

Sessions will also focus on payroll, personnel and benefits information gathering and reporting. System enhancements in these areas will also be covered. For more information on the conference, contact Personnel Data Systems, Inc., 15 E. Ridge Pike, Conshohocken, PA 19428; 215-828-4294.

And Once Again . . .

Atlanta, GA will play host to the latest installation in the continuing Comdex saga—Comdex/Spring '84 will be in three separate convention centers on May 20–23. The show will feature its usual hardware and software vendors as well as sessions on business, marketing and financial interests.

For more information, contact The Interface Group, Inc., 300 First Ave., Needham, MA 02194; 800-325-3330, or from within Massachusetts, 617-449-6600.

Gay Paree in the Springtime

Micro Expo, one of Europe's largest microcomputer shows, will be on May 22–26 in Paris, France. In addition to the exhibition, the show will offer panels and conferences led by computer experts from many countries. The expo is designed with engineers, educators and management professionals in mind.

For more information, contact Dianne Brock, show coordinator in the United States, 2344 Sixth St., Berkely, CA 94710; 415-848-8233 or Telex 3336311.

Computer Country Fair—NH

The first annual Computer Country Fair and Exposition will be held June 1–3 in Stratham, NH. The fair, which is sponsored by the Exeter Area Chamber of Commerce, will feature software and hardware for everything from games to sophisticated business applications.

Food and refreshments will be available at the fair, as well as activities for all ages. The fair will be on the campus of the New Hampshire Voc-Tech College.

For more information, telephone Julianne Cooper at 603-778-0344.

CLUB NOTES

SW Connecticut IBM PC Club

The IBM PC User's Club of Fairfield County, CT meets on the fourth Tuesday of each month at 6 p.m. in the Darien Public Library.

For information, write or call Davis Foulger, 69 River Road, New Canaan, CT 06840; 203-966-9378.

Long Island Computer Group

The Long Island Computer Association, Inc. (LICA) is open to amateurs and professionals with an interest in computers, computer applications, programming or related subjects.

Dues are $12 per year and include a monthly newsletter. Meetings are held on the third Friday of each month at the New York Institute of Technology, Old Westbury Campus, at 8 p.m. in Room 508, Building 500.

LICA also has secondary rap sessions with smaller groups. Topics for this year include assembler language, a general beginners course, more on data communications, early Basic programming, computer graphics and hardware savvy. For more information, contact Al Levy, PO Box 71, Hicksville, NY 11802; 516-293-8368.

Chameleons in the Big Apple

The International Chameleon Users Group (ICUG) has recently been formed for owners of the Seequa Chameleon. Membership is $18 per year and includes a monthly report on the latest technical details specific to the Chameleon. For more details, write ICUG c/o Joe Verzino, PO Box 265, Dewitt, NY 13214; 315-446-2763.

North Texas IBM PC Group

The North Texas IBM Personal Computer Users Group is a nonprofit independent group, not associated with IBM Corp. Members receive a free monthly newsletter and may participate in special interest groups. They also can take advantage of such IBM support programs as user group telephone lines, bulletin boards and newsletters.

The group meets on the second Saturday of each month at the Jesuit College Preparatory School, 12345 Inwood Road, Dallas, TX 75231.

GA: From Peanut Fields to Computer Clubs

The Middle Georgia Computer Club has hardware user groups and special interest groups for Commodore VIC, the TRS-80 I, II, III, 4 and Color Computer, Timex Sinclair, Texas Instruments, Victor, IBM PC, Apple and others.

Membership is $20 per year ($10 for students). For more information, write MGCC, PO Box 2821, Macon, GA 31203-2821.

Kentucky Club for Heathkit and Zenith

The Louisville Heath Computer Users Group (LHUG), is open to amateur and professional Heathkit and Zenith Data Systems users. Members and nonmembers may attend meetings and write articles to the free monthly newsletter. The group offers members use of the local HUG software library and a ten percent discount at the Heathkit store.

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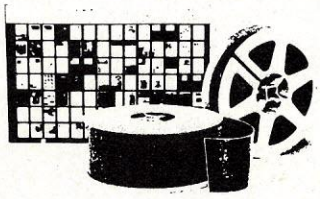
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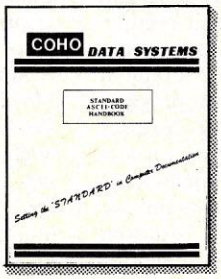
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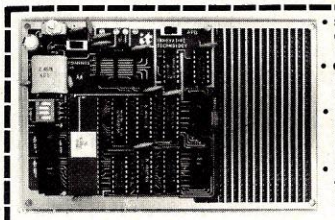
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Word Processing on the Tandy Model 100
Software for the Collector of CP/M Utilities
DoubleDOS—Enhancements for MS DOS

Scribe 3.1: Radio Shack Model 100s

Scribe 3.1 is a word processor and text formatter for the Model 100. The program, written in Basic and occupying 2.1Kb of memory, works with the Model 100's built-in Text program and provides full text-formatting features (including left, right, top and bottom margin definition), centering, forced page breaks, automatic page numbers, headers, footers, variable line spacing and more.

Scribe supports special dot matrix printing effects, such as double-width characters, and it can send control code sequences to your printer. It does not, however, support underlining, superscripts or similar features that require embedded control codes.

Scribe has a command that lets you pause printing to enter text from the keyboard, and a "buffered typewriter" feature that lets you write and print small documents without having to create a Text file. It prints documents of any length, from any combination of memory and cassette files, and it can compute the number of characters in a document.

Scribe 3.1 also has a mail-merge facility that prints custom form letters from names and addresses contained in a data file, which you create using the Model 100's Address (ADRS) program.

Scribe 3.1 sells for $29.50, plus a $2 handling charge. Chattanooga Systems Associates, PO Box 22261, Chattanooga, TN 37442. Reader Service number 489.

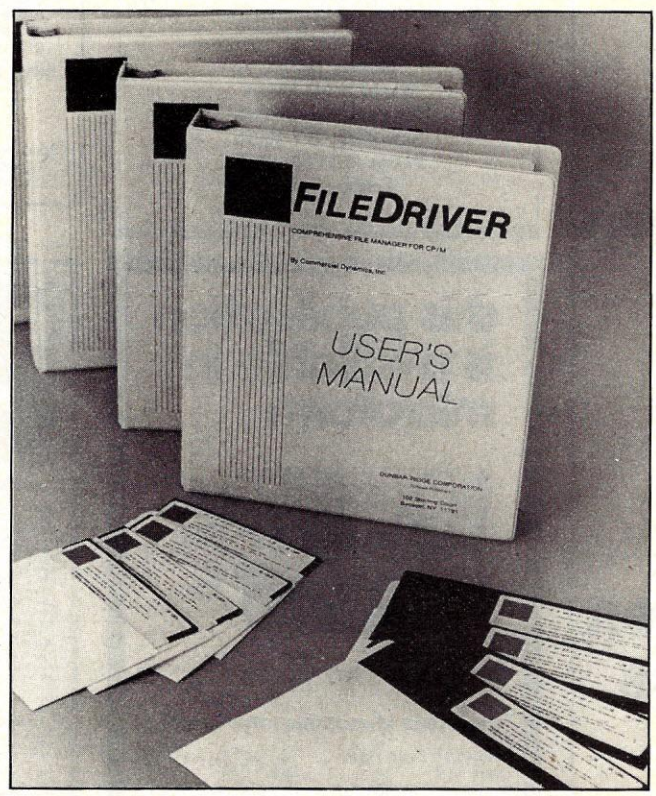
Create Custom Utilities

FileDriver is a collection of utilities for CP/M, MP/M and TurboDOS systems. FileDriver provides basic utility functions like Archive, ATTR, CDump, CSub, Copy, Erase, LISTF, Print, Rename, TY, Verify and more, and also adds features that the operating systems' utilities lack. FileDriver lets you specify multiple wild cards on a command line and supports wild card user-areas and disk drives. Its other features let you exclude lists of files from a wild card designation, write to and read from text files, act across user-area boundaries, and copy and archive to sequential floppy drives. FileDriver supports attribute flags and group numbers.

You can access FileDriver utilities three ways: from individual command files, from an all-in-one command file and from a menu interface. FileDriver doesn't modify the operating system or replace the CCP. It runs along with other utilities and with menu interfaces, provided that they leave enough memory.

FileDriver's documentation includes application notes, appendixes and summary charts. FileDriver has a 30-day money-back guarantee.

The software (supplied on an eight-inch CP/M-format disk) with manual costs $85; most 5¼-inch disk formats are available for $90. Dunbar-Ridge Corp., 102 Sterling Court, Syosset, NY 11791. Reader Service number 480.



FileDriver lets CP/M, MP/M and TurboDOS users create application-specific, customized utilities.

IBM Operating System Enhancer

An operating system enhancer that lets the IBM PC and PC XT accomplish two functions simultaneously has been announced by SoftLogic Solutions. Called DoubleDOS, the program acts as an extension to MS DOS 1.1 or 2.0 and adds several enhancements to the DOS system. The keyboard type-ahead buffer has been increased from 15 characters to two buffers with 80 characters each.

DoubleDOS divides your system's memory into two areas, one for each program that will be running. The memory can be divided in any way you choose between the two programs. You can load a program into either memory area and run it, without access to the keyboard, in what's called the "background." Any displays the program produces are trapped and written into a special portion of DoubleDOS. When you recall the program from the "background," its current screen is displayed, reflecting any processing that occurred while the program was running in the background.

The program requires no hardware modifications and

works with a monochrome display or a color display or both. DoubleDOS runs on systems with as little as 128Kb, depending upon the actual application software, but 192Kb of memory is recommended.

If you have both a monochrome monitor and a graphics display, you can choose to utilize either one for the background or the normal application.

DoubleDOS is priced at $299. SoftLogic Solutions, 530 Chestnut St., Manchester, NH 03101. Reader Service number 482.

The Key II 1-2-3

Key II is a macro program that operates within a 1-2-3 worksheet and is claimed to reduce the keystrokes required for information management by more than 90 percent.

Key II consists of six analysis routines and accommodates worksheet files with up to 30 fields and 1800 records. Its distribute routine, for example, produces cross-tabulations of worksheet databases in a variety of formats.

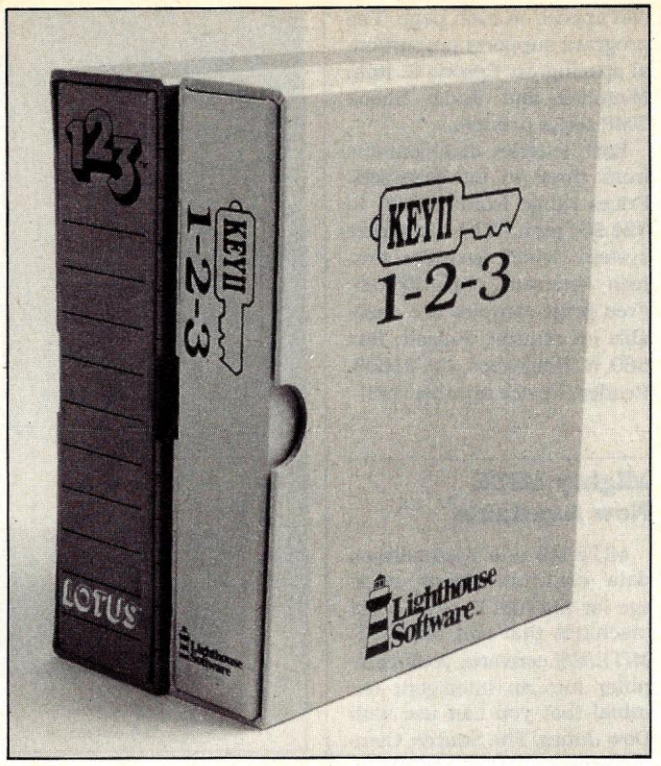
Key II operates on the IBM PC and compatibles and sells for $189. Lighthouse Software Corp., PO Box 15, Hilton Head Island, SC 22938. Reader Service number 490.

Microsoft Productivity Software for Mac

Microsoft has announced three more software packages for Apple's Macintosh: Word, Chart and File.

Microsoft Word for Macintosh exploits all the features of the Mac's user interface, including pull-down menus and the mouse. It also uses the Macintosh's extensive graphics capabilities to allow full visual representation of text and graphics on the screen, including proportional spacing and support for all Macintosh typefaces.

Word lets you move text between documents using the Mac's standard cut, copy and paste functions. It can also merge information from other documents, or from Microsoft File, into form letters.



Key II is a macro program for 1-2-3 that's said to reduce by 90 percent the keystrokes required for information management.

Microsoft Chart lets you enter, edit and format graphics data in windows on the Macintosh screen. Data can come from Multiplan or File or from any other Macintosh program. Chart provides a pictorial "gallery" of over 40 available chart and graph styles—bar, line, pie, scatter and so on—that you can choose from and switch between. You can also customize your charts by using the mouse to select formats or options. Finally, you can choose a number of typestyles and sizes, and you can position headings, titles and other text anywhere on the chart.

Microsoft File is a database manager that offers forms-based data entry and retrieval. You can specify all the characteristics of the forms. Your data files can be used to supply information to any application that reads and writes text files, such as Word's mail-merge feature.

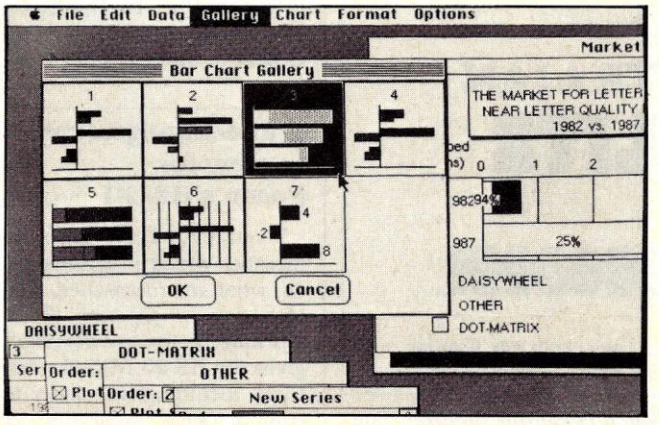
Word and File are priced at $195 each; Chart goes for $125. Microsoft Corp., 10700 Northup Way, Bellevue, WA 98004. Reader Service number 487.

Compuview's Fast File-Transfer Utility

Systran, a new utility from CompuView Products, moves data between MS DOS and CP/M-format disks. Systran runs under CP/M-86 on the IBM PC and on most 8086-based micros and requires two floppy disk drives 5¼- or 8-inch) and 64Kb of memory. Although MS DOS is not required, Systran can produce MS DOS-format disks from CP/M disks. The program converts data files from CP/M format to MS DOS format (including MS DOS 1.1 and 2.0) and vice versa.

Other recent additions to CompuView's line include: V-Spool, a text buffer; VPrint, a text formatter; and, Modem-86, a universal telecommunications program utility for 8086 machines and many S-100 micros.

The Systran disk and manual are priced at $120. CompuView Products, Inc., 1955 Pauline Blvd., Suite 200, Ann Arbor, MI 48103. Reader Service number 481.



Microsoft Chart for Apple's Macintosh.

A Graphics Program For Jr

Jr-Draw is a symbol-oriented graphics program for IBM's PCjr that produces charts, schematics and diagrams. The program has two symbol libraries (software design and symbol design) and multiple text fonts. The program lets you design your own symbols and supports an optional light pen.

Jr-Draw requires an IBM PCjr with 128Kb of memory and one disk drive. The system is offered for a ten-day trial period.

Jr-Draw sells for $195. Micrografx, 1701 N. Greenville, Suite 703, Richardson, TX 75081. Reader Service number 491.

Making Peace Between Unix and MS DOS

Idris, a Unix-compatible operating system designed to coexist with MS DOS, has been introduced by Whitesmiths, Ltd. The system's multitasking capabilities allow up to three users to work interactively on many MS DOS-based computers.

Idris allows you to access both Idris and MS DOS application programs and to

alternate and communicate between the two operating systems without having to reboot the computer. Further, any Idris application may be moved to a number of microprocessors using Whitesmiths' C and Pascal compilers and cross compilers.

Idris contains nearly 100 of the most widely used Unix utilities and requires no more than 128Kb of memory and less than 1.5Mb of disk space for efficient operation. Whitesmiths claims Idris runs on "more than a dozen systems, including the IBM PCjr." The company is also demonstrating Idris on the 68000-based Sage IV microcomputer.

Idris for the IBM PC is priced at $550. Whitesmiths Ltd., 97 Lowell Road, Concord, MA 01742. Reader Service number 484.

More Fonts for Dotwriter

Prosoft, makers of the Dotwriter graphics and text formatter that runs on the TRS-80 Models I and III, has released 16 new typestyle disks, containing a total of 120 new lettersets.

You can mix any two character sets on a print line, and an unlimited number of sets can appear on each page. The program supports proportional spacing on Epson, C. Itoh, Microline and Radio Shack DMP-series printers.

Each letterset disk contains from three to ten lettersets. Prices range from $17.95 to $24.95 each. The Dotwriter system, which includes thirteen lettersets, costs $79.95. Free print samples are available on request. Prosoft, Box 560, N. Hollywood, CA 91603. Reader Service number 492.

Mighty MITE Now Available

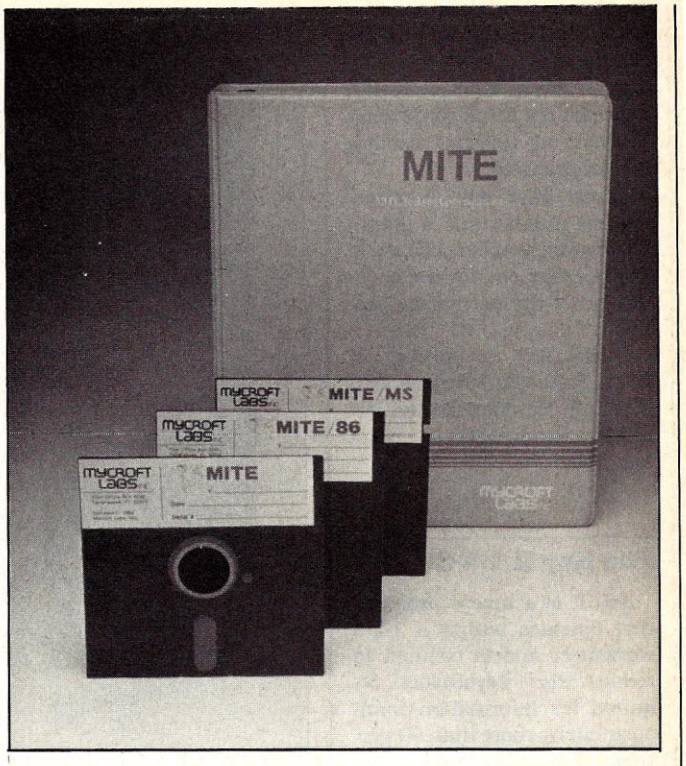
MITE/MS is a menu-driven data communications package for the IBM PC and other machines that run MS DOS. MITE/MS converts your computer into an intelligent terminal that you can use with Dow Jones, The Source, CompuServe and other popular information services. You can also use MITE/MS to transfer text and binary files between computers.

MITE/MS gives you full control over communication parameters such as parity, bit rate and so on. You can also define up to ten programmable macro keys, which can be invoked with a keystroke. You can use the macro keys to set up automatic log-on sequences, for example.

In addition to text file uploading and downloading features, MITE/MS supports three binary file protocols—X-modem, CLink/Crosstalk and Hayes. These protocols let you transfer files with error checking and automatic retransmission.

MITE/MS is available installed for the IBM PC XT, Columbia, Compaq, Corona, Victor and other MS DOS-based machines. CP/M-80 and CP/M-86 versions are also available. Accompanying the program is a reference manual that includes tutorials on data communications and RS-232C interfacing.

MITE/MS sells for $195. Mycroft Labs, Inc., PO Box 6045, Tallahassee, FL 32314. Reader Service number 493.



MITE/MS is a version for MS DOS machines of the popular MITE communications program.

A File-Management System for Epson's HX-20

If you're tired of trying to remember which programs are on what microcassettes, File Management System (FMS) 1.0 may be the answer. FMS gives the HX-20 DOS-like features, including the ability to run or save programs by name only; automatic catalog updating of all program additions or deletions; simple catalog display or printout; program lock and unlock functions; and the ability to merge programs.

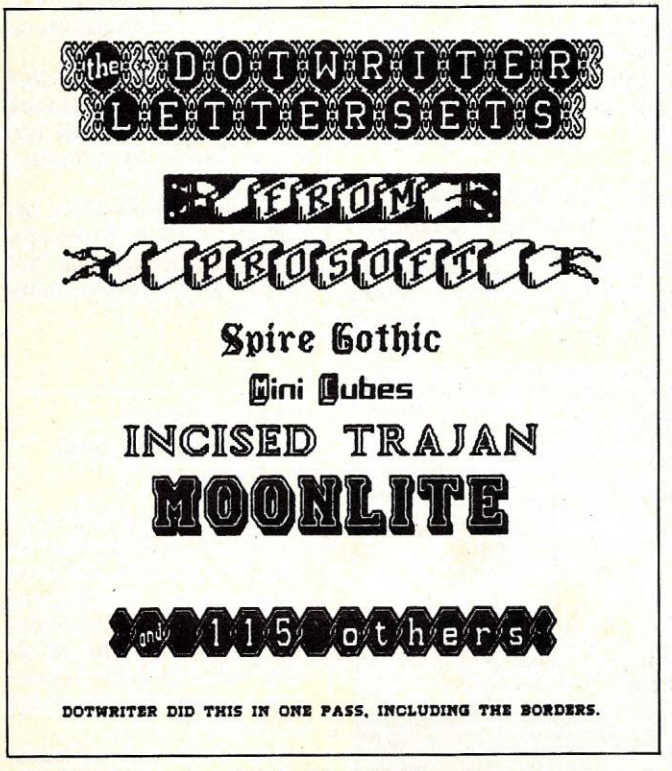
FMS provides 22 file-management commands, including a help command that displays FMS commands. FMS supports Basic, ASCII text, machine language and sequential data files.

FMS 1.0 retails for $49.95. Computer Software Services, PO Box 9702, Phoenix, AZ 85068. Reader Service number 485.

Library of C Functions Introduced

Greenleaf Software has introduced an extensive library of C functions for use with the IBM PC and PC compatibles. Called the Greenleaf Functions, the library contains more than 200 functions and routines designed for use with the Lattice C and Microsoft C compilers and with Computer Innovation's C86.

The Greenleaf Functions provides access to MS DOS 1.x and 2.x disk, printer and string routines, and adds routines in 13 categories, including video, graphics, color text and graphics, keyboard



Sample print generated by Prosoft's Dotwriter program and letterset disks.

(including function keys), time and data, serial communications, math and diagnostics.

The package's documentation includes demonstration programs, examples, source code listings, a reference card and a subscription to a programmer's newsletter.

The Greenleaf Functions sells for $175. Greenleaf Software, Inc., 2101 Hickory Drive, Carrollton, TX 75006. Reader Service number 483.

A Profoundly Ironic Word Processor

Leading Edge Products has released the Leading Edge Word Processor, the program that's the subject of all those enticing silver ads on the back covers of computer magazines.

The Leading Edge Word Processor, for IBM PCs and compatibles, is claimed to transform a PC into a dedicated word processor, combining both power and ease of use. The program features cursor control by character, word, line, sentence, screen and page (both forward and backward); a Goto Page command; automatic pagination, including widow and orphan control, split screen or window operation; and glossaries.

The program's attributes features support underline, boldface, various typestyles, superscripts and subscripts, strike through, double-width letters and support for eight colors. The Leading Edge Word Processor can also merge data from dBaseII and Lotus 1-2-3 files.

Novices (or users with unreliable computers!) will appreciate the automatic save, automatic document recall, undo deletion and automatic back-up features. All commands require only one or two keystrokes.

The Leading Edge Word Processor lists for $295; the program with Merge Print sells for $350. Leading Edge Products, Inc., 21 Highland Circle, Needham Heights, MA 02194. Reader Service number 488.

Telecommunications From the pfs People

Software Publishing Corp. has introduced pfs:Access, a telecommunications program for the Apple IIe and for MS DOS-based machines. pfs:Access works with all major information services and provides data encryption to help ensure privacy and security. The program remembers dial-up and log-on sequences, allowing you to sign on by pressing one key.

pfs:Access supports uploading and downloading. The program lets you transmit pfs:Report files and ASCII text files, and you can direct incoming information to a buffer for later review.

pfs:Access supports most popular modems and transmissions speeds of 300 and 1200 bits per second. The Apple IIe version retails for $70, while the MS DOS version sells for $95. Software Publishing Corp., 1901 Landings Drive, Mountain View, CA 94043. Reader Service number 494.

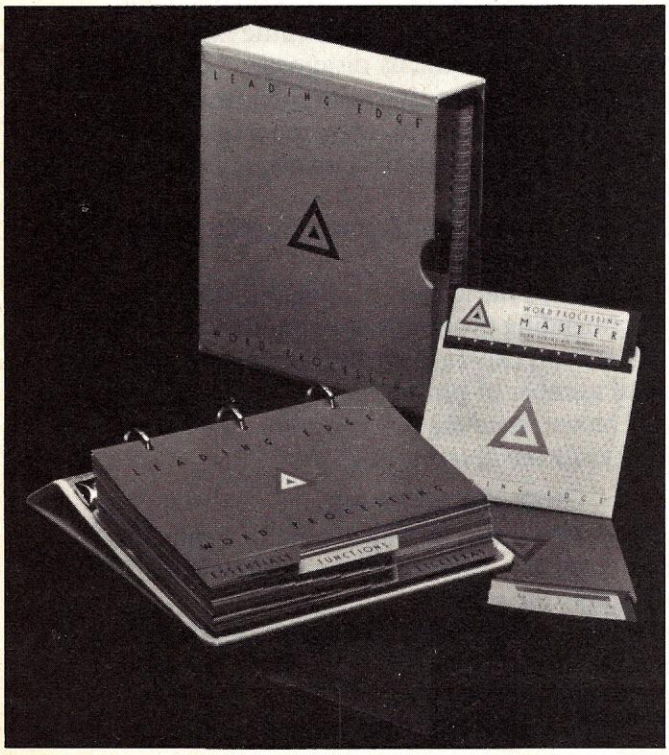
RAM Disk and Keyboard Utilities For Epson's QX-10

Frustrated by the fact that the QX-10's version of CP/M doesn't address the machine's full 256Kb of memory? MicroRAM is a program that turns the wasted memory into a 167Kb RAM disk.

A companion program, QX-Keys, lets you reconfigure your QX-10's keyboard to your liking. Source code is included with QXKeys.

MicroRAM sells for $80; QXKeys, for $25. MicroNova, RR #5, Canning, Nova Scotia, Canada B0P 1H0. Include $2 for shipping. Reader Service number 486.

Correction: Client Write-Up, (New Software, *Microcomputing*, February 1984,) should have been priced at $1495. The general ledger program is available from Micronetics, Inc., 1926 Hollywood Blvd., Hollywood, FL 33020.



The Leading Edge Word Processor for IBM PCs and compatibles.

Program Solutions

1) What's wrong is that a comma has been inadvertently typed instead of a decimal point between the 3 and the 26 in line 1670. Basic returns a syntax error not only when lines contain incorrect sequences of characters, but also when data in a Data statement doesn't match the type of variable in the Read statement. See page A-21 of the Basic Programming Manual.

2) The reason you get a "Too Many Files" statement has nothing to do with the number of files on the disk. This error is also generated when the file specification given is invalid. The correct specification for saving a file in ASCII format is SAVE "errfrag.bas",A, where the A goes outside the quotation marks.

THE TRUTH ABOUT SOFTWARE.

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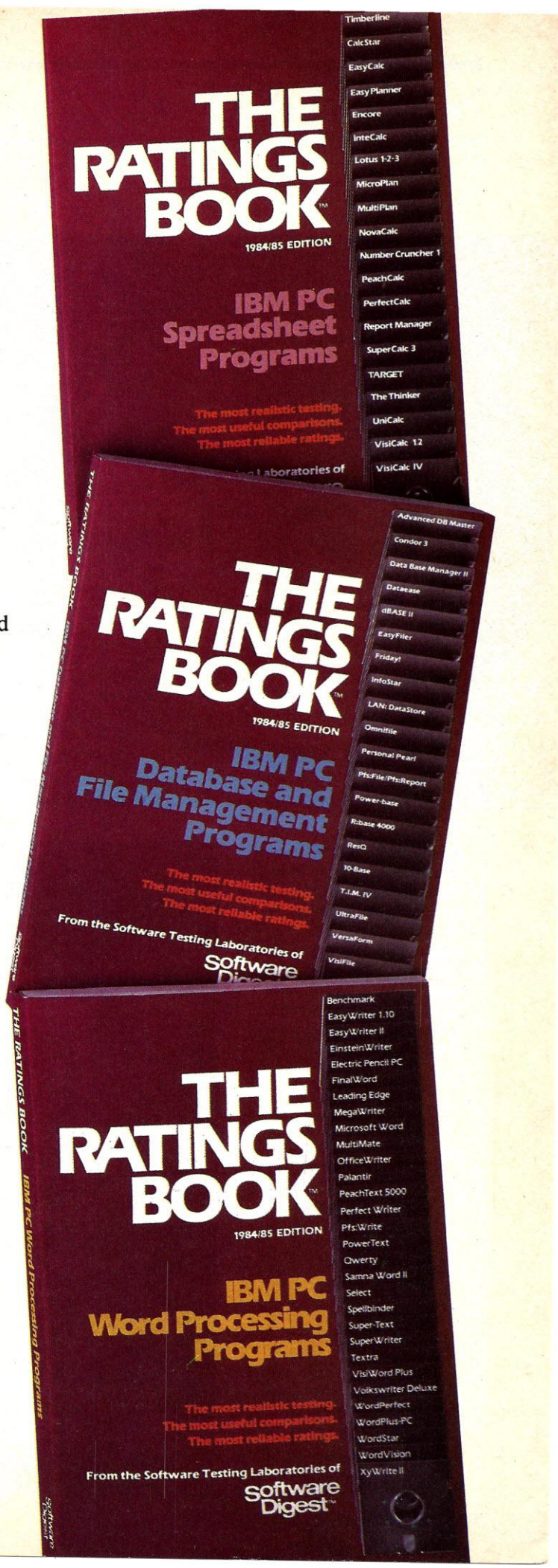
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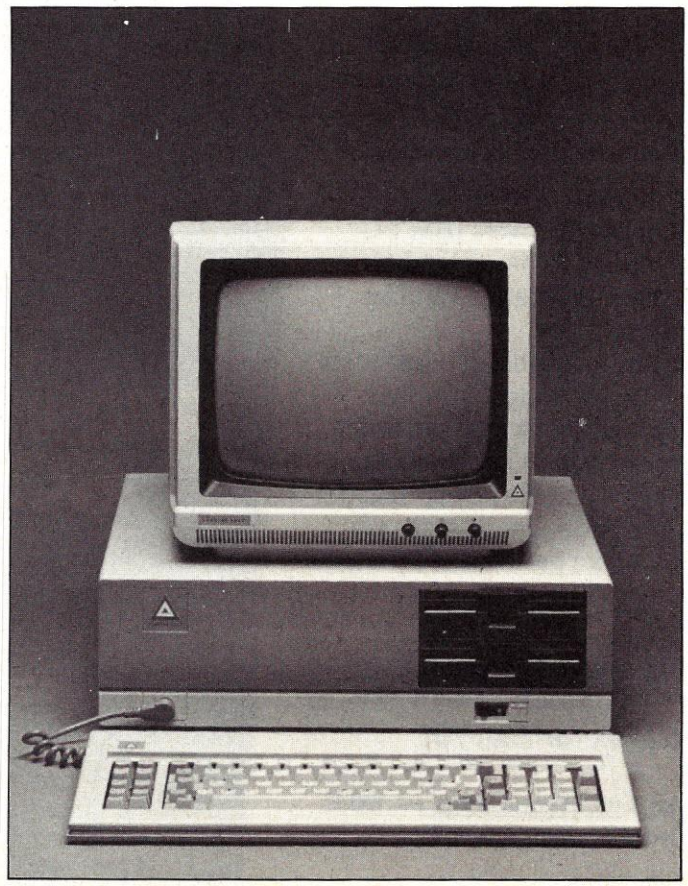
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Above: Video Vision Associates' VAI-135, a videodisk computer interface for the Apple II and IIe.

Right: The Leading Edge Personal Computer features IBM PC compatibility, a 7.16 MHz 8088 CPU, 128Kb of memory and bundled software.



Videodisk Interface For Apple IIs

Video Vision Associates has introduced a videodisk computer interface for Apple II and IIe computers that lets you control most consumer laser videodisk players.

The VAI-135 is an external interface that plugs into the Apple's game paddle port and, according to the manufacturer, doesn't interfere with joystick operation. The interface is said to be compatible with Pioneer videodisk player models VP-1000, PR-8210 and LD-1100, and with Magnavox's VC-8010 and Sylvania's VP-7200.

The VAI-135 has a software-controlled video switching feature that lets you switch video output from the disk player or the Apple to a color monitor. The unit includes software that contains sample exercises and an "authoring program." You can also write your own interactive programs using Basic.

The VAI-135 videodisk interface retails for $125. Video Vision Associates, 7 Waverly Place, Madison, NJ 07940. Reader Service number 475.

A Leading Edge IBM Clone?

It sounds like a contradiction, but Leading Edge Products has introduced an IBM clone of its own called The Leading Edge Personal Computer. The machine uses an 8088 microprocessor, running at 7.16 MHz (versus the IBM's 4.77 MHz), and contains 128Kb of memory and a built-in RS-232C serial port. It provides seven IBM bus-compatible expansion slots and a digital clock with battery backup.

The Leading Edge PC's keyboard is an IBM-style unit with 83 keys. It uses inductive technology and, according to Leading Edge, can be washed. The machine's double-sided, double-density, half-height disk drives store 320Kb each. Its monitor has a 12-inch nonglare screen.

The Leading Edge Personal Computer comes bundled with MS DOS 1.25, GW Basic and the Leading Edge Word Processor. It has a six-month warranty and retails for $2895. Leading Edge Products, Inc., 21 Highland Circle, Needham Heights, MA 02194. Reader Service number 461.

Another Graphics Board for IBM PCs

Multigraph is a new graphics adapter board for IBM PCs and compatibles that use either a color or monochrome monitor. It features 32Kb onboard memory (expandable to 128Kb) and the ability to run software written for the IBM color board on systems equipped with only a monochrome monitor.

Offering monochrome graphics in two different modes with a resolution of 720 by 350 dots, Multigraph is said to be compatible with Lotus 1-2-3. Its manufacturer, Profit Systems, also says the board is the only one of its kind to have an internal 32-bit architecture and to offer optional soft scrolling. Optional upgrade kits provide color graphics resolution of 640 by 200 or 640 by 400 in 16 colors or a monochrome resolution of 720 by 700 with 132-column displays. An optional parallel printer port is also available.

Multigraph retails for $499. Profit Systems, Inc., PO Box 1039, Berkley, MI 48072. Reader Service number 466.

Three Peripherals For Macintosh

Tecmar is jumping aboard the Macintosh bandwagon with the introduction of three delicious-sounding add-ons—Apple Fritter, Apple Jack and Candy Apple.

Apple Fritter is a 300/1200 bps, Bell 212A-compatible modem and telephone system. The self-contained unit features touch-tone decoding, pulse or tone dialing and a voice interface that lets you use it as a telephone by simply adding a handset. You can also use the system to remotely enter data or commands from any touch-tone phone. Apple Fritter can be used with any RS-232C-equipped computer.

Apple Jack is a 5Mb removable cartridge Winchester disk system. Tecmar's claim is that Apple Jack combines the speed of a conventional Winchester disk with the removability and transportability of a floppy disk. The drive itself is manufactured by Syquest.

Candy Apple is an IEEE-488 interface that lets Mac owners use peripherals designed for this bus, including equipment made for laboratory, test and measurement, and process control applications. Candy Apple uses Intel's 8291A and 8292 integrated circuit set and provides Macintosh computers with talker, listener and controller capabilities.

All three Tecmar peripherals are housed in cabinets that match the Macintosh's styling. For price and availability information, contact Tecmar, Inc., 6225 Cochran Road, Solon, OH 44139. Reader Service number 463.

Give Eyes to Your IBM

PC-Eye is a video-capture system for IBM PCs that lets you capture video images directly from video cameras and recorders at up to eight frames per second. The unit is designed for graphics and image processing, surveillance and security, quality assurance, motion analysis, machine vision and training.

Images are digitized with one or two bits of intensity for compatibility with the IBM high-resolution graphics adapter, or digitized with four bits of intensity (640 by 400 pixel resolution) for display by other compatible graphics adapter boards. Other resolutions and partial image transfers can be selected under program control.

The image is transferred under DMA control directly to the PC's memory at speeds up to 1Mb per second. Successive frames can be captured and stored for later comparison or processing.

Software support is offered for printer output, annotation, storage, comparison, compression and transmission of the video information. PC-Eye sells for $500. Chorus Data Systems, Inc., PO Box 810, Hollis, NH 03049. Reader Service number 476.

Thermal Transfer Printer

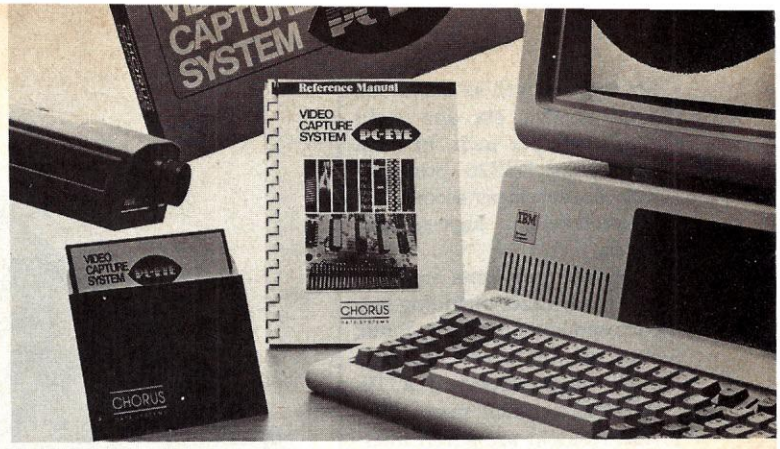
Fujitsu America has introduced an 11-pound, 16-dot thermal transfer printer that produces near letter-quality printing on a variety of materials, including vinyl.

The TTP 16 combines the thermal transfer process with a print ribbon, eliminating the need to use special thermal paper. This feature lets the TTP 16 print on plain paper, labels, overhead transparencies and so on. The printer has a 16-dot serial thermal head that provides resolution of $\frac{1}{120}$ by $\frac{1}{120}$-inch in a single pass. Other features include vertical and horizontal tabulation and paper-out and ribbon-end alarms. Single-color ribbons are available in black, yellow, magenta and cyan.

Fujitsu claims that the TTP 16's noise level is rated at less than 50 dBA because the printhead never strikes the printing surface and because all moving parts are driven by stepper motors. In its near letter-quality mode, the TTP 16 prints at 45 characters per second.

The TTP 16 is capable of printing bold, double-strike, expanded, compressed, pica, elite, italic and underlined styles, and supports superscripts, subscripts and proportional spacing. It's equipped with both RS-232C serial and Centronics-type parallel interfaces. The printer measures 4.7 by 14.2 by 10.8 inches and weighs 11 pounds.

The TTP 16 retails for $625. Fujitsu America, Inc., 3055 Orchard Drive, San Jose, CA 95134. Reader Service number 469.



PC-Eye is a $500 vision system for the IBM PC that processes images from video cameras and recorders.



The Fujitsu TTP 16 is a $625, 16-dot thermal printer that prints on plain paper.

A Multi-mode Dot Matrix Printer

Datasouth Computer Corp. has announced its DS220 multimode dot matrix printer, that contains an Intel 8085 microprocessor and provides three print modes—correspondence quality, draft quality and a dot-addressable graphics mode.

In correspondence mode, the DS220 uses an 18 by 48-character matrix and a two-pass printing technique to print at a speed of 40 characters per second. In draft mode, the printer uses a 9 by 7 matrix and offers a selection of ten, 12 and 16 characters

per inch as well as expanded print at five, six and eight characters per inch. In draft mode, the DS220 prints at 220 characters per second in a bidirectional, logic-seeking mode.

Several type fonts are built into the DS220, including two correspondence-quality fonts, two memo fonts, variable-pitch draft fonts and a 16-character-per-inch micro font. Also resident are seven international character sets. Datasouth also claims that more type fonts are under development.

The DS220 has a four-digit LED display and front-panel switches that let you access 50 programmable features. The printer includes both RS-232C serial and Centronics-type parallel interfaces and a 2000-character buffer. It uses snap-in ribbon cartridges.

The DS220 retails for $1995. Datasouth Computer Corp., 4216 Stuart Andrew Blvd., Charlotte, NC 28210. Reader Service number 471.

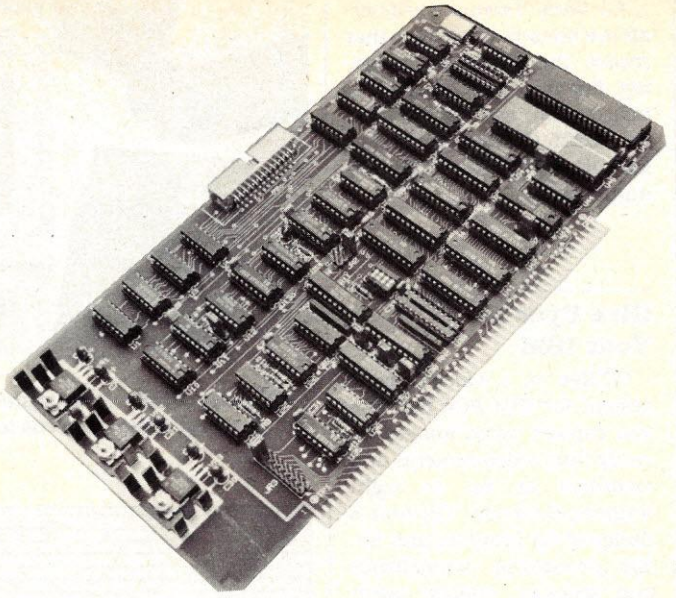
Array Processor For IBM PCs

An array processor designed to let an IBM PC or compatible perform complex mathematical calculations up to 10,000 times faster has been introduced by Helionetics, Inc.

Called the APB-3000PC, the board fits into one of the PC's expansion slots. According to the manufacturer, array processors work by performing repetitive computer operations simultaneously and eliminate the need to repeatedly access main computer memory. The company says the APB-3000PC is ideal for simulation, digital signal processing, robotics and other computation-heavy applications.

The APB-3000PC is controlled with Fortran or Basic, running under MS DOS. A high-level assembler and monitor package is also available for custom microcode development.

Prices for the APB-3000PC begin at $2000. Helionetics, Inc., 17312 Eastman St., Irvine, CA 92714. Reader Service number 468.



Seattle Computer Products' 8086 CPU runs at 10 MHz and delivers 16-bit performance to S-100 computer systems.

10 MHz 8086 CPU Board for S-100 Systems

Seattle Computer Products has introduced an 8086 CPU board for S-100 computer systems. Two versions of the board are available: a 10 MHz version and an 8 MHz version designed for use with an 8 MHz 8087 numeric coprocessor.

Seattle Computer claims the new boards can operate with either eight- or 16-bit peripherals and have a unique design that lets them address up to 16Mb of memory. A board can be used as a stand-alone CPU; together with Seattle's SCP-301 Support board; or as part of a three-card CPU/CPU support/memory-management unit set.

MS DOS is available for the 8086 board from Seattle Computer; Xenix is scheduled for release soon. For price information, contact Seattle Computer Products, Inc., 1114 Industry Drive, Seattle, WA 98188. Reader Service number 467.

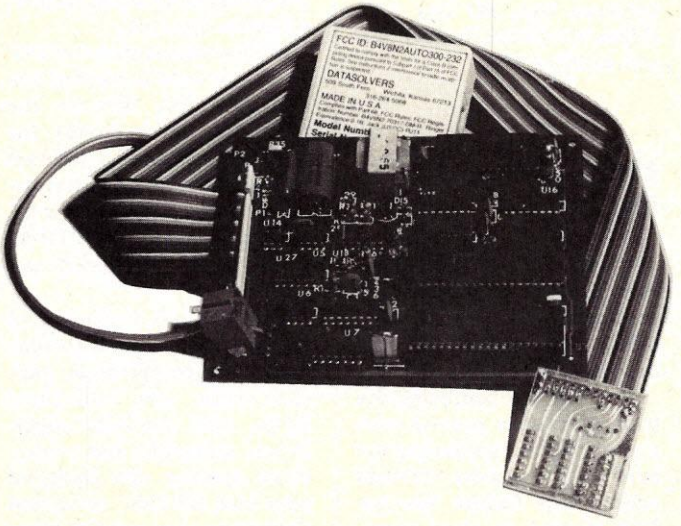
High-Performance Hard Disks

Percom Data Corp. has introduced what it calls a new generation of hard disk drives. Called PHD, the new drives use a memory caching scheme that Percom claims makes the drives five times faster in data transfer than the IBM PC XT's hard disk.

The caching design lets the PHD drive work with the host computer to store and process often-used files in memory and then transparently return them to the hard disk.

The PHD product line is now available for IBM PCs equipped with at least 256Kb of memory and supports MS DOS 2.0. According to Percom, PHDs for IBM-compatible micros will be available soon. The caching driver "personality kit" will have a suggested retail price of $149.95. Prices for the PHD hard disk begin at $1895 for a 5Mb drive.

Percom Data Corp. 11220 Pagemill Road, Dallas, TX 75243: Reader Service number 465.



The DS1200SMT, from Datasolvers, is an internal 1200 bps intelligent modem for Kaypro computers.

New Printer Buffer With 64Kb Memory

Taxan is expanding its line of computer peripherals to include the Model 500, a printer buffer with 64Kb of memory that's expandable to 256Kb.

The Model 500 features a Centronics-compatible parallel interface, a multiple-copy function that prints up to 255 copies of a document, and a pause function that temporarily halts data output.

The buffer can route the data to two sets of printers simultaneously and has an LED display that conveys status information and indicates which printer is in use.

The Model 500 retails for $325. Taxan Corp., 18005 Cortney Court, City of Industry, CA 91748. Reader Service number 470.

Internal 1200 bps Modem for Kaypros

A 1200 bits per second intelligent modem that fits inside a Kaypro II, 4 or 10 has been introduced by Datasolvers, Inc. According to the manufacturer, the DS1200SMT installs with no drilling, soldering or modification required. The modem emulates the Hayes 1200 command

structure and can be connected to any standard direct-dial modular phone line.

The DS1200SMT comes with communications software, all necessary cables, documentation and a 90-day warranty. It retails for $427.50. Datasolvers, Inc., 440 Maple, Wichita, KS 67213. Reader Service number 473.

Half-Height Drives For Apple IIs

Apple has introduced a disk drive unit that contains two half-height, 140Kb drives placed side by side. Called Duodisk, the new drive unit is said to be fully compatible with Apple II software and less expensive than two separate Disk II drives.

Duodisk is the same width as the Apple II and can sit between the computer and monitor. Its case was designed to match the Apple II and the Monitor II, creating a more integrated look. According to Apple, the unit boasts technical improvements, including a new disk eject mechanism and a head-positioning mechanism that allows more precise reading of half-tracks.

Duodisk retails for $795 and includes a controller card that connects it to any Apple II, II Plus or IIe. It's covered by a 90-day warranty. Apple Computer, Inc., 10260 Brandley Drive, Cupertino, CA 95014. Reader Service number 464.

Hard Disks for Mac From Davong

Davong Systems has announced Mac Disk, a family of hard disk storage systems for Macintosh computers that offers between five and 40Mb of storage. Detailed specifications and price information isn't available at press time; however, sources report that a 10Mb Mac Disk will sell for $2395 and a 40Mb Mac Disk for $4495. Prices include all necessary cables, adapters, software utilities and documentation.

Also in the works from Davong are a 28Mb streaming tape backup system and Mac Link, a multitasking local area networking system that lets up to 255 Macs communicate with each other and share hard disk storage, printers, plotters and other peripherals.

Davong Systems, Inc., 217 Humboldt Court, Sunnyvale, CA 94086. Reader Service number 462.



Duodisk is a new disk drive unit from Apple that houses two 140Kb drives and sells for $795.

Circle 297 on Reader Service card.

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-5vlt. → .5amp / -12vlt. → .5amp $69.95
·30 day warranty

IBM Makes Its Own PC Portable

The IBM Portable Personal Computer is a transportable PC that contains a nine-inch amber screen, one 360Kb, 5¼-inch slimline disk drive (with space for a second), 256Kb of memory, an 83-key keyboard and a color graphics monitor adapter.

The 8088-based computer weighs 30 pounds and measures 20 by 17 by 8 inches. It contains the same motherboard used in the PC XT and features seven expansion slots and a universal power supply that lets you use it in different countries by adding the appropriate power cord.

The Portable Personal Computer sells for $2795. Options include a second disk drive ($425), a printer adapter, 64/256Kb memory expansion, a math coprocessor and a game control adapter. IBM, PO Box 2989, Delray Beach, FL 33444. Reader Service number 474.



The IBM Portable Personal Computer weighs 30 pounds and includes 256Kb memory and a single 360Kb disk drive.



Hewlett-Packard's HP-7550A is claimed to be the fastest plotter available in its class and the first to offer automatic cut-sheet paper feed.

Hewlett-Packard Introduces Fast New Graphics Plotter

Hewlett-Packard has introduced a new plotter that it claims is the fastest B-size (11 by 17) plotter available. The HP-7550A plots on either 8½ by 11- or 11 by 17-inch paper with a pen speed of 31.5 inches per second. The plotter features automatic cut-sheet paper feed (similar to the feed method used by Canon copiers), a liquid-crystal display for reporting plotter status and program messages, front-panel function keys for controlling the plotter, and a Replot command that draws up to 99 copies of a graph without rerunning a program.

The HP-7550A uses fiber-tip pens for paper and transparency film, and roller ball or liquid-ink pens for drafting applications. The fiber-tip pens are available in ten colors and two line widths. Pens are loaded onto the plotter in eight-pen carousels that provide automatic plotter settings by pen type for pen speed and pressure. The HP-7550A prints on 8½ by 11- or 11 by 17-inch paper, transparency film, vellum, polyester film and tracing bond.

The plotter boasts an addressable resolution of 0.001 inch (0.025 mm) and a mechanical resolution of 0.00025 inch (0.006 mm). Additional features include 20 international character sets in two fonts, including Japanese Katakana and most European languages; user-definable character set capability; arc and circle generator; a line-pattern generator; polygon definition and area-fill commands; point digitizing; a built-in self test; and block mode I/O error checking and recovery for RS-232C.

The HP-7550A has both IEEE-488 (HPIB) and RS-232C interfaces. The plotter can either be connected directly to the computer or in series between a terminal and the computer.

The HP-7550A retails for $3900. Hewlett-Packard, 3000 Hanover St., Palo Alto, CA 94304. Reader Service number 460.

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(From p. 146)

on the manual. They admitted that the original manuals were hurried into production, pointed out that the manuals I had were not current, and said the new ones have corrected the problems.

Mosaic Software uses screen photographs to illustrate how many of the input forms should look. This is a very helpful addition to any manual—other manufacturers should consider similar assistance for purchasers of their software.

The documentation is consistent between the two programs (an obvious but often neglected feature). The installation instructions are menu-driven. Program defaults are easily changed if your system changes. The software is copy protected using a key disk system. The program can be copied any number of times, but it can't be used without the key disk. The key disk can only be backed up once. This still leaves you with a problem if you manage to lose the key disks. But, the odds aren't as great that you'll do that as they are that you'll lose a program file, so I don't object as much to this form of copy protection.

These programs also allow you to transfer all files to a fixed disk and boot the program from the fixed disk without using the key disk. This is another plus for the key disk system of copy protection.

Both programs require an IBM PC computer with 128Kb of memory and DOS 1.1 or higher. One double-sided disk drive is required, but you'll save a lot of swapping around if you use two drives. The charts and graphs can be printed on the Epson series printers with GraphTrax or the IDS Prism color printer. HP 7470 and 7220 plotters and the IBM XY-750 plotter are supported.

Operation—Dazzling

Program operation is straightforward and menu-driven. The input screens take a little getting used to, but once you're comfortable with them, data entry is accomplished with speed and accuracy. The ability to customize the color of the entry screens is a nice feature if you find the colors chosen don't suit your taste.

Both of these programs are written in compiled Basic. As a result, they run quite fast and make full use of the IBM PC BasicA graphics capabilities. I ran the programs on an IBM PC with an RGB color monitor. The graphs were clear and easy to read. Line graphs are difficult to read on a monochrome monitor if more than one or two lines are plotted. This isn't a problem with the color monitor, where each line is plotted in a different color. Otherwise, either a color or monochrome monitor works perfectly well with these programs.

> Chartman II's results with a color monitor are spectacular—the slide show option may be the key to selling an ideal or thought.

Actually, the results with the color monitor are spectacular—especially the slide show option. It's a real treat to see your data displayed in color and flashed instantly on the screen with no distracting setup activity. For a small group presentation, the slide show may be the key to selling an idea or thought. If you don't dazzle them with your intelligence, you'll still dazzle them with your brilliance (on the screen, that is).

Super Chartman II supports all the basic graph types: line, bar and pie. It also creates three-dimensional bar graphs and pie charts and pie-bar combination charts. Figs. 1 and 2 give you an idea of how the graphs appear on the screen. The real bonus is that the program supports common plotters so presentation-quality graphs are a snap to prepare.

Chartman IV's most stunning trick is the presentation of text charts on the screen of your computer. The screen photographs can only give you a hint of how impressive a slide show of text and graphics material can be. It's a real eye opener!

Transportability of data is always a concern for me. I have a great many files in 1-2-3 and VisiCalc form that I want to be able to use with a graphics package. While 1-2-3 has nice graphics capabilities, it doesn't have the slide show ability or all the features included in Super Chartman II. Mosaic includes directions on moving data from DIF format to Super Chartman II. In every file I moved, the data exchange worked exactly as advertised and I lost nothing in the process . . . another pleasant surprise.

Super Chartman II and Chartman IV both contain one other useful feature. If you are in the habit of making many presentations, you'll find the text preparation section of both programs useful. Super Chartman II can create text of various fonts in 8 sizes. Using a plotter or printer, you can create title pages and other presentation-size printing on slides or transparencies. Chartman IV allows you to create text charts on the screen. Coupled with graphs, the text charts make for a very slick slide show. Again, the ability to create tailor-made professional presentations is built into both programs.

Special Features

Chartman IV has two other features not yet covered: an organization chart generator and a Gantt chart generator. Both are often used in large organizations to show information or progress on projects under way. If you need to make numerous charts and graphs of this nature, this program may be useful. In the case of the Gantt charts, you may wish to explore programs designed to monitor project performance in a more detailed way. This program simply takes data you've provided and graphs it. Other programs track your projects, produce the charts, update them and give you various task lists and progress reports based upon your data entry.

Conclusion: New Heights

I highly recommend Super Chartman II. It provides a good graphics package with some nice extra features, like the slide show and text preparation.

Chartman IV isn't as versatile. If you need the features it provides, the program is very good at doing what it's designed to do. But other programs can do a good job with Gantt charts, and charts with text are available in Super Chartman II (although not on the screen). You'll have to make a lot of organization charts in a month to make this program cost-effective if that's the only reason you're purchasing it. What I'd like to see are the area and scatter charts and on-screen text put on Super Chartman II. The curve fitting procedure is more sophisticated and requires some knowledge of statistical methods to be truly useful. To be even more useful, Mosaic could expand this program into a Chartman V by adding other forecasting and statistical programs to create a disk dedicated to this type of work. There is a market for this type of software, and a good graphics package makes forecasting and trend spotting a lot easier.

In conclusion, these two well-documented programs perform as advertised. I can recommend Super Chartman II without reservation. Chartman IV is not quite as spectacular but may be just what you have been looking for.

One last comment. Mosaic software has just announced a deal with MicroPro to sell Super Chartman II, with modifications, as a MicroPro graphics package. I predict you'll see more of this young company. Mosaic has also just announced an integrated software product, to be released in the first quarter of 1984, that will compete with 1-2-3 and Context's MBA.

I've called the company several times on these programs and always received quick and courteous treatment. The company appears to be stable and headed for bigger and better things. In these

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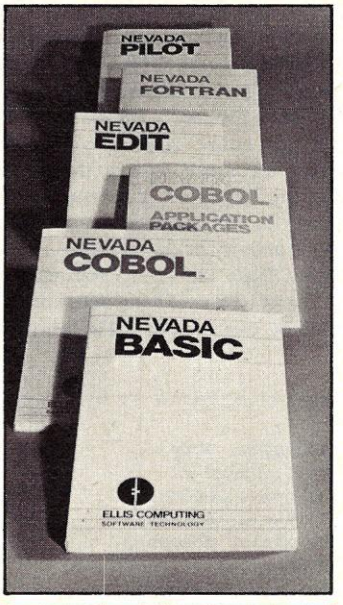
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Business Management Software

System Requirements: IBM PC or MS DOS system; minimum 128Kb RAM; two 320Kb disk drives or floppy and hard disk.
Manufacturer: Datamension Corp., 615 Academy Drive, Northbrook, IL 60062.
Price: $495.

Datamension's Business Management software collection offers three separate programs to help you manage better and use your time productively. While each is a self-contained application, all are designed to work together and pass information to each other. Files can also be used by a fourth Datamension product—the Report Manager three-dimensional spreadsheet.

Though each program addresses a different problem, all share a common user interface. Commands are entered in the same way as they are for a first-generation spreadsheet such as VisiCalc—you type a slash (/) and various lettered options appear at the bottom of the screen. It's up to you to remember which command each letter stands for.

To shorten the learning process, however, all three programs do share some commands. For example, /AC alters a category listing regardless of which program you're currently using.

Task Manager

Efficient management requires the ability to organize and schedule time. Task Manager helps you do this by providing a monthly calendar, a daily schedule and financial reporting for nine different accounts.

Task Manager essentially works at two levels: month and day. When the program starts, a calendar is displayed for the month you've specified. Each day for which you've scheduled an activity is highlighted. To view the detailed activities for a particular day, you move to that date using the cursor keys and press the return key. Instantly, the schedule for the day is displayed.

Items on your schedule can be assigned various priorities and associated with certain activities. For example, you can schedule an appointment (A) for a set time or arrange events in descending order of importance (priority of 1 or 2).

You can form a "to do" list to ensure that very important tasks aren't missed, even if not completed on the desired date. An activity with star (*) priority that has not been marked as completed will move to the current date.

A permanent entry is used for special events that fall on the same date year after year, such as anniversaries and birthdays. Even when you establish a new data disk for a different year, these entries can be carried forward.

Entering a new event requires selecting a date from the monthly calendar. When that day is displayed, press the return key. You see a prompt to enter the priority of the activity, the category and any descriptive text. For an appointment, you also enter the time of the meeting.

Task Manager will then rearrange the day's activities with the most important at the top of the list (*), followed by scheduled appointments and then the lower priority items.

Time is the important element with many activities; Task Manager uses the IBM's built-in time-of-day clock not only to display the current time but also to time events. You can establish an elapsed-time entry on the daily schedule. Pressing the computer's F4 function key starts and stops a special timer that records the elapsed time of the activity.

The program has a number of other features that make it more useful. A keyword filter can be used to find all events that meet specific criteria. For instance, typing /K Miller turns on the keyword filter for "Miller." Pressing Shift-Tab runs the entire schedule through the filter; only those events including Mr. Miller are displayed. You may specify up to three keywords in order to select the precise activity or day desired.

With Task Manager, you can assign any event to one of nine accounting categories by using a special symbol preceding a dollar amount in the text description. This feature is useful for keeping track of expenses, hours worked per activity and so on.

The filter command is used to select which activities are included in the totals. You can further define the totals to encompass a range of days or months (global total) or simply keep a running total of activities on the days that you display.

While this limited math capability is a far cry from a complete accounting system, creative use of the filters can produce an accurate picture of expenses and income for either an entire organization or one project. I find Task Manager fairly straightforward once the commands are mastered. The only real constraint is the amount of data Task Manager can store. It's best to save only essential activities in nonactive years.

```
>Anderson, Judy L.
 Bell, Diane R.
 Bergman, Sandra K.
 Cardwell, Louis F.
 Carlisle, Joseph Q.
 D'Agostino, Richard C.
 Devon, Kathleen M.
 Enders, Emily K.
 Farwell, Gwendolyn P.
 Goodman, Donald R.
 Harrison, Barbara A.
 Hart, Nancy T.
 Hawkins, Helen S.
 Horowitz, Rodney E.
 Jarman, Reginald P.
 Johnson, Lloyd B.
 Lesage, Brian J.
 McNulty, Wanda C.
 Merion, Karl G.
 Orwell, Morton
 Peyton, Francine E.
 Riddle, Sarah B.
[ENTER] [CTRL-Q] [ARROWS] Data / :
```

Fig. 3. Records Manager, General level.

Records Manager

There are literally hundreds of record keeping programs on the market, each with unique capabilities for particular tasks.

Datamension's Records Manager is a database program specifically designed for client and employee information tracking. It helps to organize employee records, track projects and maintain resume information. You can also update project and resume information entered as Task Manager activities.

Records Manager has an interesting structure. For example, when the program starts, the screen shows a listing of all the people on file. This is the General level. (See Fig. 3.) Positioning the indicator next to a specific name and pressing return switches the display to a Detailed Record level for this individual, as shown in Figure 4. Press return again to see a list of projects this person has worked on or Project level. (See Fig. 5). Press return yet another time and you'll see his resume on the Resume level. (See Fig. 6.)

A set form is supplied for entering data about people, such as name, address, department and date of salary review. Records Manager contains a set of commands to sort records by up to nine different fields and generate reports containing only certain fields from each record. You can design a report listing only a person's name and social security number or one that contains name, address, phone number, birthday and so on.

Records Manager's command system allows you to save up to 52 different screen or printer layouts for the General and Detailed level; that breaks down to 26 designs each. These can be named, saved to disk and used whenever you need to view records in different ways.

While creating these different layouts takes practice, after a few tries things go quickly. The process does require a bit of concentration and time, and it's best to design a new layout on paper first.

Records Manager uses a simple editing

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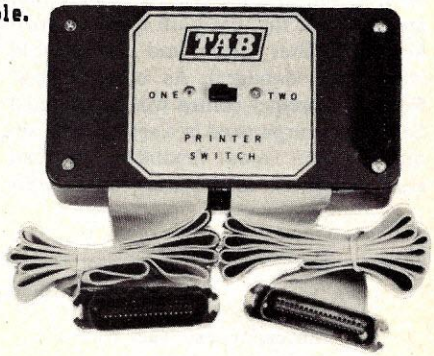
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is needed at that location. The math step screen displays the indicated line along with the item numbers for that line. You can double-check the work to be sure the correct math step is entered. Only one math step is needed to add multiple lines and columns using the exclusive block add feature of the Number Cruncher system.

Go to Run model and the screen displays your newly created model. Press the return key and the cursor stops at all data entry points. You should type only the numbers applicable to that location. The decimal points and punctuation previously provided are now placed by the system. The calculator keys may be used for entry, preventing possible errors.

Fantastically Fast

As the numbers are entered, the computed items are instantly calculated by the program at an incredible speed and displayed on the screen. Once the last number is entered, it's possible to return to the run menu and immediately print the report.

Even after the completed report is printed, the program provides a way to make changes. The system recalculates in a split second. It's very easy to play "what if".

The same procedures, menus, screens, function keys, commands and math steps described above for the spreadsheet can be used for preparing a model for a letter. If the same letter is to be addressed to more than one person, AA's (variable alphabetic information) are placed at the location of the name and address. The AA's allow the Number Cruncher system to assign item numbers for those locations.

Numerics, calculations and/or a spreadsheet can also be included in the letter, which can be up to ten pages long. Endless business applications are possible with the ability to combine text, numerics and calculations into a customized format.

The systems design section of the manual gives detailed information regarding the questions a designer must ask to create a model. The designer needs to know the size, the information and space needed for each item and the items to be used for sorting (numeric and/or alphabetic).

Being able to design and use your own records with the Number Cruncher system allows you the freedom to set up records with the information that you want. You're more familiar with the results needed to manage and operate efficiently.

If you don't wish to design your own formats, Pyramid Data currently has modules available to be used with the Number Cruncher program, such as Amortization, Invoice Preparation and Payroll.

By using the Number Cruncher's ability to combine text, numerics and calculations, you can create purchase orders, invoices, inventory records, check generation programs, mailing lists and much more. The designs are limited only by the creativity of the user.

Margaret Jones
Scottsdale, AZ

Bookends

System Requirements: Apple computer; 48Kb or 64Kb system.
Manufacturer: Sensible Software, 6619 Perham Drive, West Bloomfield, MI 48033.
Price: $124.95.

Bookends is one of those programs that come along every so often that not only have a specific purpose in life, but are friendly, easy-to-learn, and do what they says they will.

Fast Track

In effect, Bookends is a bibliography-oriented database for your Apple. You enter the information you want to track (book or article title, publication name and date, author and so on), and Bookends files it for you. It then searches through your records to pull out the information you need according to specific instructions you give it.

You can perform these searches based on author names, article titles and so on, or on keywords that you use to identify your information. You can search on multiple criteria and instruct the system to find a match if any part of your search data matches exactly or only if all of your conditions are met. If you keep track of articles, for example, from *Microcomputing*, you can search for all by a particular author, an individual title, everything referenced to graphics and so on.

Since the package was developed to create bibliographies, the fields that store your information are already designed. The system tracks the title, journal, volume, page number(s), date, publisher, keyword(s), a special classification code and even lets you enter an abstract that outlines the text of the material. Each of these fields can be up to 760 characters in length.

Disk Details

The longer your records, the fewer you can store on each data disk (the average is between 450–900 records per disk). However, the size of your files is memory-dependent, as the memory inside your Apple controls how large a file you can pull from disk into RAM space. A 48Kb system, for example, allows you to retrieve a file that holds between 85 and 170 individual records at one time. But even with this space limitation, you can chain files together to test them against the search criteria you need. Bookends advises you of the remaining available memory.

The system was designed with the Apple IIe in mind, as it accepts and displays upper- and lowercase input. If you have a lowercase adaptor, the system recognizes and uses it. Even for those of us with older Apples, Control-S toggles from upper- to lowercase; uppercase letters are displayed as inverse characters.

Bookends comes with two copy-protected disks and programs for both 48Kb and 64Kb systems. The package checks your Apple and loads the right one automatically. A 64Kb system gives you more complete error messages and prompts and allows wild card searches, where an equal sign can be used in place of the character(s) you don't know. Help is available from the main program disk, but you won't need much for the basic entry/retrieval functions, as they're easy to learn and use. The system is menu-driven, so it's easy to move around in. The 96-page indexed manual is designed as a reference but has a good three-section tutorial that starts you right off by working with two sample files on disk.

Editing commands are understandable and fast. You can escape from just about anywhere with the Escape key. The system is super fast when you move from menu to menu or record to record. It's Reset protected. I asked the program to load a file and "accidentally" left the door on my disk drive open. This didn't bother Bookends at all and no information was lost. It simply told me I had a problem and returned to the menu. The data for your latest entry acts as a default for your next one; you can copy any or all fields into the new record, rather than typing the information again.

Featuring . . .

One of the strongest features of Bookends is its capability to design different formats for the bibliographies you create. You might store an author's name as *Beil, Donald H.* You can ask the program to print it like that, of course. If you prefer, you can rearrange the different part of the author's name and print them as *Beil, D.H.* or *Beil, Donald* or *Beil, DH* or as *Donald H. Beil.*

This may be the strongest part of Bookends, for while the system functions well as a data manager, it's extremely flexible when it comes to formatting your information. You can keep four format designs in memory at any one time, and you can save as many as you want on disk. Your files can be saved as standard text files, so they can be read by some Apple word processors and/or spelling checkers.

Minor Flaws

As with most programs, Bookends isn't perfect. The system can't work with an 80-column card (which would make it even better for Apple II Plus micros). The package is very DOS oriented, which means you see the entire disk catalog when you load or save a file and get DOS

won't operate to select the various projects or tasks. There's an optional way to do this (by entering the name directly), but it takes more time. I'd rate the typewritten documentation good, but it needs more examples, especially Project Manager. This is a very difficult concept and the manual doesn't make it any clearer.

In all, the programs that make up the Manager collection do what they're designed to do: manage time, people and resources more productively. They're supported by Datamension's telephone hot line, a data disk for each program with examples to get you started and on-line help functions included with each program. If you get over the initial learning pains and the few program stumbling blocks, these programs live up to their promise to increase productivity.

Michael Heck
Harleysville, PA

Number Cruncher

System Requirements: IBM PC, IBM XT, Compaq, Corona or Columbia computer; MS DOS; 128 Kb; two 320 Kb disk drives; printer with 132-column capability and/or compressed print feature; monochrome or color display.
Manufacturer: Pyramid Data, Ltd., 1050 W. Katella, Orange, CA 92667.
Price: $395.

The Number Cruncher program is a sophisticated, easily used design tool limited only by the creativity of the user. It offers a completely integrated system of number crunching plus full database management, information management, text editing (word processing), applications generation and spreadsheet abilities. This program not only teaches you how to design your own tools to do all of the above, it also teaches you how to use your designed tools in the day-to-day management of information.

The Number Cruncher program can currently be run on the IBM PC, IBM XT, Compaq, Corona and the Columbia. Clearly defined instructions are included for building a bootable number cruncher system for each of the above computers.

Pyramid Data has been designing and supporting applications for many popular minicomputers for almost a decade. They are now bringing their experience to the personal computer, and it's self-evident in the Number Cruncher program. Users require different types of training and reference points, and Pyramid has provided fantastic training aids for the Number Cruncher.

Easy to Learn

The system is easy to learn and operate. The program disks contain demonstration and training sections, with book and instructions to be printed and used as quick reference points. In addition, audio and video training cassettes are available for training more than one employee at a time. Pyramid Data has regional offices throughout the United States for full support. If all of the above fail, a national toll-free hot line with courteous help is available.

The manual is concise and carefully thought out. The reference section covers all operations in depth. The math section completely covers each math step and its functions. The systems design section is the real meat of the program and includes complete instructions. The three appendixes include command summaries, capacities and samples, such as change decimals, fractions, an amortization table and internal menu (Dallas statistics). An index completes the manual.

The Number Cruncher system is completely menu-driven and you are in full control. The ease of operation is incredible when you consider the enormous capacities: 3400 items, 720 math steps and ten pages for each report. The largest number that can be displayed is 99,999,999,999 and the largest possible value is 999,999,999,999,999. It's possible to prepare 30 small reports or a combination of small and large reports on each storage disk. You can format, check disk space, delete models from a storage disk and copy a storage disk without ever leaving the program. Complete built-in help files are accessible for all menus and screens.

Creating a Report

Designing a report or model is simple. From the main menu, you choose a new menu to set up a report or model. At the new menu, you create a model format and are given choices, such as number of pages and width of model (80 or 132 characters wide). While creating the model, you're free to move around the screen, using the function keys to move the cursor.

Important aids are on the screen during the creation of the report or model. At all times, the gauge is at the top of the screen labeled in 10-position (column) increments. The page, line and position (column) numbers are displayed so you know the location of the cursor and are in full control. When creating a 132-column model, the columns between position 80 and position 132 as well as the gauge are shown at the middle of the screen. The full width of the report is displayed. The bottom of the screen displays the function key numbers along with an abbreviation of their functions.

When creating the model or report, you only type in information that won't change. If you're preparing a report with a centered heading, "as of" date, description heading and headings for three columns, you type everything except the date (the date is different for each report). In its place, you type XX/XX/XX. The XX's, typed with their punctuation, indicate to the program that you'll be placing

> Number Cruncher is a sophisticated, easily used tool that's limited only by the creativity of the user.

placing numeric values at these positions (values that will change with each report). The F7 (duplicate) key is used to duplicate characters from the line above the cursor's location to the line the cursor is on. This is invaluable in preparing a report with many descriptions and columns. It is only necessary to use the F7 key at the first column of each line; the entire line of each heading is then filled with XX's—a big timesaver. The program is capable of having 4,000 XX's per page.

When a new report is created, you depress the F8 (done) key and return to the new menu, where you determine your print size (normal or compressed). Then you're ready to print your model format. If changes need to be made, you select Edit an Existing Model Format, which returns you to your model on the screen to make any desired changes.

Conversions and Commands

Once the model is created, the program does the conversion for you, one line at a time. Next, you print the converted model. The conversion changes the XX's to OO's and their designated punctuation. Punctuation and decimals are determined by the manner in which the XX's were previously placed.

Print the layout sheet to simplify the input of the math steps. On the layout sheet, the OO's have been replaced by item numbers, one item number for each "XX" type item. The program assigns the item numbers and allows the system to address the numeric fields.

One of four commands may be entered at each time number:
1) a data entry point (the data or amounts that will change with each report).
2) a constant number (a number that will never change such as # months in a year).
3) a computed number (the result of a math step).
4) a math step point (where math steps are entered to perform a function). The four commands are easy to remember and, if necessary, a quick reference can be made to the convenient flipcards at the top of the keyboard.

Depressing the bracket character "[" or F10 and M keys indicates a math step

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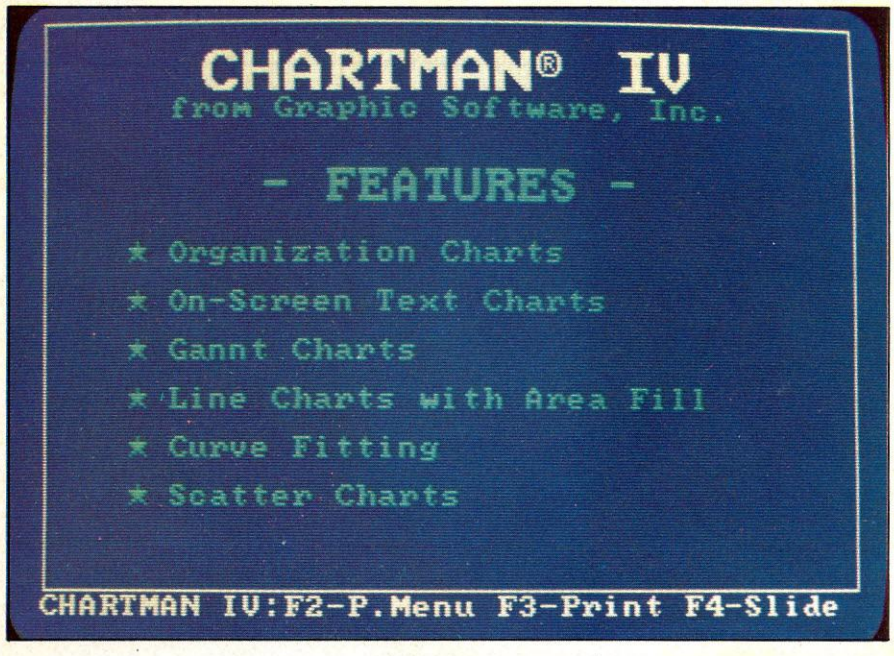


Fig. 1. A sample of a text chart prepared with Chartman IV.

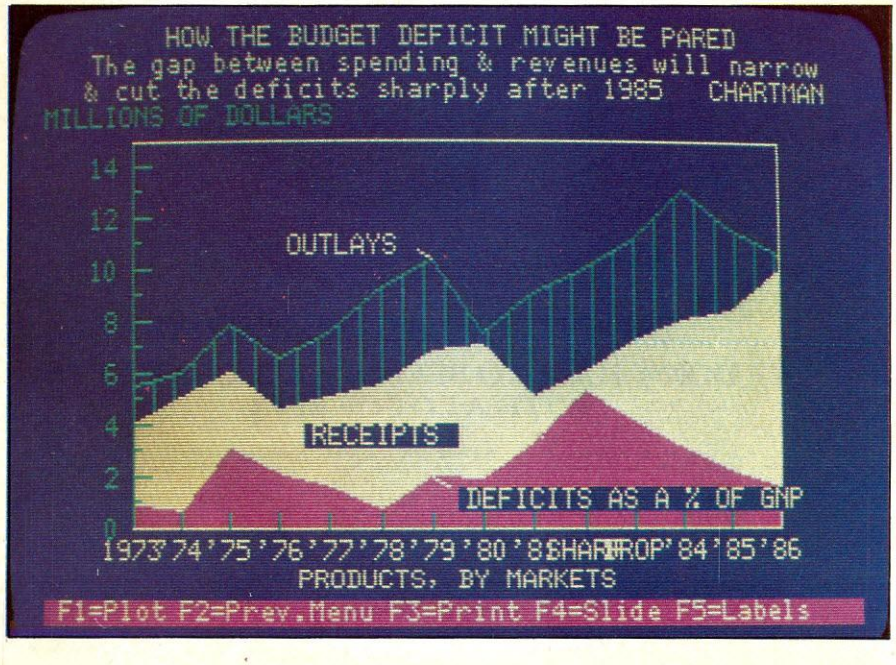


Fig. 2. An area chart from Chartman IV graphing several data sets.

Chartman II and IV

System Requirements: IBM PC or compatible; 128 Kb; DOS 1.1 or higher; one double-sided disk drive; graphics board; color or monochrome monitor.
Manufacturer: Mosaic Software, Inc., 1972 Massachusetts Ave., Cambridge, MA 02140.
Price: Super Chartman II, $425. Chartman IV, $350.

Super Chartman II and Chartman IV, offered by Mosaic Software, Inc. (formerly Graphic Software) of Cambridge, MA, are not necessarily designed as a package. However, the two programs use the same user interface and together make a very complete graphics library.

Super Chartman II is a compiled version of Chartman II, a business graphics package that creates most of the graph types used in normal business presentations: bar, line, stacked bar and pie.

Where Chartman II leaves off, Chartman IV takes off. Chartman IV creates area fill graphs and has utilities to create organization charts and Gantt charts. It also has a curve fitting utility that allows you to do both trend spotting on tabular data and preparation of on-screen text slides.

The programs support a number of printers and plotters. A series of graphs may be saved to disk and then run in slide show fashion if you wish to make a presentation using the monitor as a slide projector. This technique is especially effective for small group presentations.

Creeping Errors

Mosaic Software's documentation, in the versions of the programs I tested, appears to have been rushed into print. Spelling errors creep in fairly regularly, and there seems to be some duplication of material. Chapters 4 and 5 both deal with hardware requirements, for example, and much information is repeated. I called Mosaic about other questions I had and mentioned my observations

(Continued on p. 138)

messages when you make a mistake. This can be uncomfortable for some people who don't want to speak computerese.

As you print, the screen doesn't clear, so you watch strange characters wander across it during this process. Finally, there's no word wrap for your data—when your text reaches the right-hand edge of your screen, it splits, even in the middle of a word. This isn't bad for fields like author and page number, but if you enter a lot of outline information into the abstract field, for example, it's difficult to read. The data prints properly, though, which is the important thing.

Even with its few minor imperfections, Bookends is a valuable piece of software. If you have the need to track written material and put it into bibliography form, you'll be more than pleased with the package.

Gregory R. Glau
Prescott, AZ

The Word Plus

System Requirements: Any computer running CP/M, CP/M-86 or MS DOS operating system, or an Apple computer with CP/M card.
Manufacturer: Oasis Systems, 2765 Reynolds Way, San Diego, CA 92103.
Price: $150.

If you're as subject to making typographical errors as I am (my typewriter never learned to spell, so why should my computer?), you need some way to catch those errors before any one else sees them.

I recently tested The Word Plus to see what it can do when checking both large and small documents for correct spelling. I used it extensively while writing a 200-page book. The disk files ranged in size from 1Kb all the way up to 49Kb. I was looking for a combination of accuracy, speed and ease of use. The Word Plus met the test with room to spare.

Because it's a literal word dictionary (entire words are stored for reference rather than an elaborate scheme of roots and endings), the Word Plus isn't likely to miss strange prefixes or suffixes. Either the word is a complete ditto match or it isn't. If it matches, it's assumed to be correct. If even one letter doesn't match, it's subject to question. The comparison is made in reference to a 45,000 word dictionary stored on disk. Every time you check the spelling of any file, this entire dictionary is examined.

You expect short documents to be checked much faster than long ones. Not so with the Word Plus. As it must read the entire 137Kb dictionary every time, it makes little difference how long or short your work is. You can count on waiting from one to three minutes while the matches are made, a minor drawback you appreciate only when you write something lengthy.

Once the spelling is checked, you are presented with a menu of a dozen options for each word not matched. You may then do anything from ignoring the word to correcting it (every time it appears, with a single keystroke) to incorporating it in a special dictionary. Herein lies its greatest power. If you make the same misspelling a hundred times (is it "i" before "e" or the other way around?), you need only enter the correction once. The software corrects it every time the word appears.

There are bonuses, too. It can count your words (how many times have you been up against a 5000 word limit?) and tell how many times you use each word. In the bells and whistles category, it can help with anagrams and crossword puzzles. In the essential category, its documentation is short and quite good. It's an easy system to learn and love.

I hope Oasis Systems will consider a couple of minor enhancements. The first is minor in that there is one confusing option in the menu. When you want to ignore a mismatched word, the choice you must use is "Discard the word." First time users may be afraid of having a word zapped beyond recovery (which does not happen). The other enhancement is the ability to toggle off its automatic desire to write a back-up file to disk. You are given an error mesage when this handy safety feature encounters a full disk. Otherwise, Oasis need do little more than keep on selling more copies.

Thomas Howe
Mill Valley, CA

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Project Manager can help to pinpoint operations that are critical for timely project completion.

scheme to change information once it's been stored in a record. To quickly find specific data, this program uses a refined keyword filter command (introduced with Task Manager). As noted earlier, Records Manager comes with predefined field names organized in a set form. In addition to the layout flexibility, you can also change the field names to suit your own applications.

The maximum benefit from this program can be derived from its use in the personnel area. Here's why: Records Manager files can be updated from Task Manager entries using a data link utility. This transfers information from one program's files to another.

Project Manager

This final program is a critical path and resource scheduling system. Critical path method, first developed to handle large construction projects, makes any project more manageable by dividing it into many smaller tasks. Programs of this nature help to pinpoint operations that are critical for timely project completion.

Like the previous two programs, Project Manager relies on a number of lettered commands to perform each operation. It also incorporates the general-to-detailed screen displays introduced with Records Manager: the first screen lists all current projects. Selecting a project then switches the display to tasks related to that project.

```
                Judy L. Anderson                04/13/49

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Fig. 4. Records Manager, Detailed level.

```
Title          Planned  Start    Planned  End      Result
j1003          05/01/82 05/03/82 05/10/82 05/09/82 Early!
j1002          05/01/82 05/01/82 05/15/82          N/C
j1001          04/15/82 04/16/82 05/01/82 05/01/82 On time
Ns103          02/16/82
[ENTER] [ESC] [ARROWS] Data / :
```

Fig. 5. Records Manager, Project level.

```
03/01/82        -Salary Adjustment-                    $19,500
03/01/82        Position: Editorial Supervisor
09/01/81        Note: 3 month review
09/01/81        -Salary Adjustment-                    $17,000
06/01-08/01/81  Class: Business Programming            Grade: A
05/15/81        Note: 2 yrs. previous experience
05/15/82        -Salary Adjustment-                    $16,000
05/15/81        Position: Technical Writer
```

Fig. 6. Records Manager, Resume level.

Building a critical path schedule requires you to name each activity, select its duration and indicate the activity that follows it (the successor). In many cases there will be several concurrent successors. Project Manager also lets you schedule resources to make better use of people's time.

An important aspect of Project Manager is the graphic display produced from the schedule entered. This can take the form of a typical Pert chart, showing the relationship between the tasks that make up a project; a Gantt Chart, displaying the whole project in bar graph format; or a resource chart, representing how much of a resource will be in use during a given time period.

After a project is defined and a chart is generated, you can quickly see where schedules overlap or need to be modified. The /E (Edit) command is used to change dates or schedules to make the entire project come in on schedule. Many times certain aspects of an operation remain the same, no matter what project you're working with. Project Manager provides a Replicate (/R) command to create a different production schedule from an original outline, for example.

Key dates and schedules entered with Task Manager can also be brought across into Project Manager. And, just as important, data from Project Manager can be used by Datamension's Report Manager spreadsheet. You may want to use this feature to create and track project budgets.

A Few Points

I've tried to condense a lot of information about some very sophisticated programs into a limited space to give you a feel for what these programs can do and how they operate.

In retrospect, there are a few points to keep in mind. No individual program is an ideal match for every application. If I were looking just for a database program, Records Manager might not be the first choice. It doesn't have the calculation capability or sophisticated report generation facilities needed for some applications.

Some project planning systems are much easier to use than Project Manager. The important thing to remember is that each of the Datamension programs is designed for a certain task and works with other programs in the series. That is the real difference.

All applications performed reasonably well with a good deal of error checking to avoid serious mistakes that can ruin a lot of work.

The programs can, however, stand a bit more design time. They won't recognize when the wrong data disk is used or none is present in the disk drive—the program exits to the disk operating system without any error message or warning.

I also came across a curious problem with Project Manager—the cursor keys

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